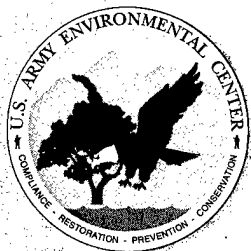


8503

CONTRACT NO. DAAA15-90-D-0017

Delivery Order 0002

Document No. SFIM-AEC-CR-98012

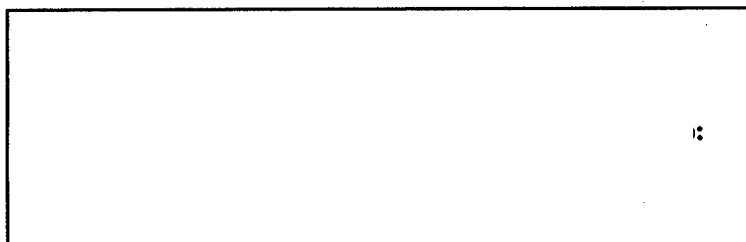


**U.S. Army  
Environmental  
Center**

**FINAL  
REMEDIAL INVESTIGATION/BASELINE RISK  
ASSESSMENT FOR THE RAVINES AND BEACH  
AREA STUDY AREAS OF THE SURPLUS  
OPERABLE UNIT, FORT SHERIDAN, ILLINOIS**

**VOLUME III -- BRA TEXT AND  
BRA APPENDICES A-L**

**April 13, 1998**



**Prepared for:**

**U.S. ARMY ENVIRONMENTAL CENTER  
Base Closure Division  
Aberdeen Proving Ground, Maryland 21010-5401**

19980618 027

**Prepared by:**

**QST Environmental Inc.  
11665 Lilburn Park Road  
St. Louis, Missouri 63146-3535**

**DISTRIBUTION STATEMENT A**

**Approved for public release  
Distribution Unlimited**

**DTIC QUALITY INSPECTED 1**

N:\DATA\PROJ\4902087\DP\SRPLS-OU\RAV-BCH.CVR

---

# **Surplus OU Baseline Risk Assessment**

## **Volume III: BRA**

Prepared for:  
U.S. Army Environmental Center  
Aberdeen Proving Ground, Maryland

Prepared by:  
QST Environmental Inc.  
St. Louis, Missouri

April 1998

QST Project No. 490-2087-0900

---



## Table of Contents

Section	Page
<b>1.0 Introduction</b>	1-1
1.1 Purpose of Report	1-1
1.2 Report Organization	1-2
<b>2.0 Identification of COPCs</b>	2-1
2.1 Site-Specific Data Collection Considerations	2-1
2.1.1 Summary of Available Data	2-1
2.1.2 Data Used in the BRA	2-1
2.2 General Data Evaluation Considerations	2-2
2.2.1 Flagging Codes and Data Qualifiers	2-3
2.2.2 Evaluation of TICs	2-3
2.2.3 Evaluation of Data from Filtered Samples	2-4
2.2.4 Blank Contamination	2-4
2.2.5 Duplicate Samples and Multiple Analytical Methods	2-6
2.2.6 Final BRA Data Sets	2-6
2.3 Determination of Site-Specific COPCs	2-6
2.3.1 Background Comparison	2-7
2.3.2 Risk-Based Screening	2-8
2.3.3 Nutritional Essentiality Screening	2-10
2.3.4 Retention of Screened Constituents Based on Site Considerations	2-11
2.3.5 Summary of Site-Specific Human COPCs	2-12
2.4 Summary of Uncertainties Associated with Identification of COPCs	2-12
2.4.1 Uncertainties Associated with Data Collection	2-12
2.4.2 Uncertainties Associated with Data Evaluation	2-12
2.4.3 Uncertainties Associated with the COPC Selection Process	2-13
<b>3.0 Exposure Assessment</b>	3-1
3.1 Characterization of Exposure Setting	3-1
3.2 Identification of Potential Exposure Pathways	3-1
3.2.1 Source Areas	3-2
3.2.2 Fate and Transport Analysis	3-2
3.2.3 Constituent Migration Pathways	3-5
3.2.4 Exposure Routes	3-7
3.2.5 Conceptual Model	3-8
3.3 Exposure Pathway Screening	3-8
3.3.1 Groundwater Pathway	3-9
3.3.2 Surface Water Pathway	3-9
3.3.3 Sediment Pathway	3-10
3.3.4 Air Pathway	3-10
3.4 Receptors of Concern	3-10
3.5 Exposure Point Concentrations	3-11
3.6 Quantification of Pathway-Specific Constituent Intakes	3-12

## Table of Contents (continued)

<b>4.0 Toxicity Assessment</b>	4-1
4.1 Evaluation of Potential Carcinogenic Risks	4-1
4.2 Evaluation of Noncarcinogenic Effects	4-2
4.2.1 Toxicity Information for Noncarcinogenic Effects	4-3
4.2.2 Constituents with No Established RfDs	4-3
4.3 Uncertainties Related to Toxicity Information	4-4
<b>5.0 Potential Risk Characterization</b>	5-1
5.1 Potential Human Carcinogenic Risks	5-1
5.2 Potential Human Noncarcinogenic Effects	5-3
5.3 Site-Specific Potential Risks	5-4
5.3.1 Potential Risks Associated with Janes Ravine	5-4
5.3.2 Potential Risks Associated with Hutchinson Ravine	5-5
5.3.3 Potential Risks Associated with the Beach Area	5-5
5.4 Risk Comparison	5-6
5.4.1 Potential Background Risks	5-6
5.5 Uncertainty Analysis	5-8
<b>6.0 Problem Formulation for the Ecological Risk Assessment</b>	6-1
6.1 Stressor Characteristics	6-2
6.2 Identification of Ecosystem(s) Potentially at Risk	6-2
6.3 Ecological Effects	6-3
6.4 Endpoint Selection	6-4
6.4.1 Assessment Endpoints	6-4
6.4.2 Measurement Endpoints	6-5
6.5 Conceptual Model	6-6
<b>7.0 Exposure and Ecological Effects Analyses</b>	7-1
7.1 Characterization of Exposure	7-1
7.1.1 Stressor Characterization	7-1
7.1.2 Ecosystem Characterization	7-5
7.2 Characterization of Ecological Effects	7-10
7.2.1 Ecotoxicity of EcoCOPCs	7-10
7.2.2 Site-Specific Study Results	7-18
<b>8.0 Potential Ecological Risk Characterization</b>	8-1
8.1 Risk Estimation	8-1
8.1.1 Janes and Hutchinson Ravines	8-2
8.1.2 Beach Area	8-4
8.1.3 Littoral Zone of Lake Michigan	8-6
8.2 Ecological Significance of Risk	8-8
8.3 Uncertainties Associated with the Ecological Risk Assessment	8-10

**Table of Contents (continued)**

<b>9.0</b>	<b>Conclusions</b>	<b>9-1</b>
9.1	Summary of Potential Human Health Risks	9-1
9.2	Summary of Potential Ecological Risks	9-1
9.2.1	Janes and Hutchinson Ravines	9-1
9.2.2	Beach Area	9-2
9.2.3	Lake Michigan	9-2
<b>10.0</b>	<b>References</b>	<b>10-1</b>

## Table of Contents (continued)

### List of Tables

Table 2-1	Sample Identifiers Included in the Human Health BRA . . . . .	2-15
Table 2-2	Sample Identifiers Included in the Ecological BRA . . . . .	2-16
Table 2-3	IRDMIS Flagging Codes in the Surplus OU BRA Data Set . . . . .	2-17
Table 2-4	NFG Data Qualifiers in the Surplus OU BRA Data Set . . . . .	2-18
Table 2-5	Background Sample Identifiers for Human Health BRA . . . . .	2-19
Table 2-6	Background Sample Identifiers for Ecological BRA . . . . .	2-20
Table 2-7	Results of ANOVA Comparing Study Area and Background Concentrations for Human Health BRA . . . . .	2-21
Table 2-8	Results of ANOVA Comparing Study Area and Background Concentrations for Ecological BRA . . . . .	2-23
Table 2-9	Comparison of Maximum Detected Constituents in Sediment to Risk- Based Screening Levels . . . . .	2-26
Table 2-10	Comparison of Detected Constituent Concentrations in Surface Water to Risk-Based Screening Levels . . . . .	2-29
Table 2-11	Basis for Developed PRGs . . . . .	2-31
Table 2-12	Final Human Health Constituents of Potential Concern (COPCs) . . . . .	2-32
Table 3-1	Physical/Chemical Properties of Organic COPCs . . . . .	3-15
Table 3-2	Physical/Chemical Properties of Inorganic COPCs . . . . .	3-16
Table 3-3	Conceptual Exposure Model of Potential Exposure Pathways . . . . .	3-17
Table 3-4	Exposure Point Concentrations (mg/L) for Current and Future Recreational Exposure to Surface Water . . . . .	3-18
Table 3-5	Exposure Point Concentrations (mg/kg) for Current and Future Recreational Exposure to Sediment . . . . .	3-19

**Table of Contents (continued)**

Table 3-6	Exposure Point Concentrations (mg/kg) for Future Worker and Recreational Exposure to Ravine and Beach Area Background Surface Water .....	3-20
Table 3-7	Exposure Point Concentrations (mg/kg) for Current and Future Recreational Exposure to Ravine and Beach Area Background Sediment .....	3-21
Table 4-1	CSFs and Potential Carcinogenic Effects for the Human COPCs .....	4-5
Table 4-2	Chronic RfDs and Potential Noncarcinogenic Effects for the COPCs .....	4-8
Table 5-1	Summary of Potential Human Health Risks Associated with Janes Ravine .....	5-11
Table 5-2	Summary of Potential Human Health Risks for Associated with Hutchinson Ravine .....	5-12
Table 5-3	Summary of Potential Human Health Risks Associated with the Beach Area ...	5-13
Table 5-4	Summary of Potential Background Human Health Risks Associated with Janes Ravine .....	5-14
Table 5-5	Summary of Potential Background Human Health Risks Associated with Hutchinson Ravine .....	5-15
Table 5-6	Summary of Potential Background Human Health Risks Associated with the Beach Area .....	5-16
Table 5-7	Summary of Uncertainty Analysis for the Ravines and Beach Area Study Areas .....	5-17
Table 5-8	Comparison of Exposure Concentrations for Inorganic COPCs to Background Levels .....	5-18
Table 7-1	Ecological Screening Benchmarks for Surface Water and Groundwater Constituents .....	7-27
Table 7-2	Illinois Administrative Code (IAC) Screening Criteria for Surface Water and Groundwater Constituents .....	7-29
Table 7-3	AWQCs for Constituents Affected by Water Hardness .....	7-31
Table 7-4	IAC Criteria Adjusted for Site-Specific Water Hardness .....	7-32
Table 7-5	Ecological Screening Benchmarks for Constituents in Sediment .....	7-33

**Table of Contents (continued)**

Table 7-6	Ecological Risk-Based Screening of Constituents in Janes Ravine Sediments . . .	7-36
Table 7-7	Ecological Risk-Based Screening of Constituents in Hutchinson Ravine Sediments . . . . .	7-37
Table 7-8	Ecological Risk-Based Screening of Constituents in Beach Area Sediments . . . .	7-39
Table 7-9	Ecological Risk-Based Screening of Constituents in Lake Michigan Sediments . . . . .	7-41
Table 7-10	Ecological Risk-Based Screening of Constituents in Janes Ravine Surface Water . . . . .	7-42
Table 7-11	Ecological Risk-Based Screening of Constituents in Hutchinson Ravine Surface Water . . . . .	7-43
Table 7-12	Ecological Risk-Based Screening of Constituents in Beach Area Surface Water . . . . .	7-44
Table 7-13	Ecological Risk-Based Screening of Constituents in Beach Area Groundwater . . . . .	7-45
Table 7-14	Ecological Risk-Based Screening Using IAC Criteria in Surface Water and Groundwater . . . . .	7-46
Table 7-15	Ecological Constituents of Potential Concern for Janes Ravine . . . . .	7-51
Table 7-16	Ecological Constituents of Potential Concern for Hutchinson Ravine . . . . .	7-52
Table 7-17	Ecological Constituents of Potential Concern for the Beach Area (Including Lake Michigan Sediment) . . . . .	7-53
Table 7-18	Physicochemical Properties for the Organic EcoCOPCs . . . . .	7-54
Table 7-19	Physicochemical Properties for the Inorganic EcoCOPCs . . . . .	7-56
Table 7-20	Wildlife Species Potentially Found or Observed at Fort Sheridan, Illinois . . . . .	7-57
Table 7-21	Common Fish Species in Lake Michigan . . . . .	7-59
Table 7-22	Food Intake Rates (IR) of Receptor Species . . . . .	7-60
Table 7-23	Fraction of Medium Ingested (FI) by Receptor Species . . . . .	7-61
Table 7-24	Exposure Frequency (EF) of Receptor Species . . . . .	7-62

### Table of Contents (continued)

Table 7-25	Exposure Duration (ED) of Receptor Species . . . . .	7-63
Table 7-26	Body Weight (BW) of Receptor Species . . . . .	7-64
Table 7-27	Averaging Time (AT) of Receptor Species, Fort Sheridan, Illinois . . . . .	7-65
Table 7-28	Fraction of Diet Consisting of Exposure Medium (D) of Receptor Species . . . .	7-66
Table 7-29	Water Intake Rates (IRw) of Receptor Species . . . . .	7-67
Table 7-30	Ecotoxicity Benchmarks for Surface Water Ingestion by Four Terrestrial Species . . . . .	7-68
Table 7-31	Summary of Ecotoxicity Benchmark Values and Observed Effects of Selected EcoCOPCs on Fowler's Toad ( <i>Bufo woodhousei fowleri</i> ) . . . . .	7-72
Table 7-32	Ecotoxicity Benchmarks for Aquatic Invertebrates Potentially Exposed to Surface Water in Janes and Hutchinson Ravines and the Beach Area . . . . .	7-73
Table 7-33	Ecotoxicity Benchmarks for Benthic Invertebrates Exposed to Sediment in Lake Michigan . . . . .	7-74
Table 7-34	Ecotoxicity Benchmarks for Sediment EcoCOPC Ingestion by Raccoons in Janes and Hutchinson Ravines and the Beach Area . . . . .	7-75
Table 7-35	Ecotoxicity Benchmarks for Ingestion of Beach Area Sediment EcoCOPCs by Snipes . . . . .	7-77
Table 7-36	Ecotoxicity Benchmarks for Snipe Ingestion of Beach Area Sediment . . . . .	7-78
Table 7-37	Ecotoxicity Benchmarks Ingestion of <i>L. variegatus</i> by Raccoons in Janes and Hutchinson Ravines and the Beach Area . . . . .	7-79
Table 7-38	Ecotoxicity Benchmarks for EcoCOPCs Associated with the Ingestion of <i>L. variegatus</i> by Snipes at the Beach Area . . . . .	7-82
Table 8-1	Ecotoxicity Quotients for Evaluation of Surface Water EcoCOPC Ingestion by Four Terrestrial Species at Janes and Hutchinson Ravines . . . . .	8-11
Table 8-2	Ecotoxicity Quotients for Evaluation of Surface Water EcoCOPC Exposure for Amphibians at Janes and Hutchinson Ravines . . . . .	8-13

### Table of Contents (continued)

Table 8-3	Ecotoxicity Quotients for Evaluation of Surface Water EcoCOPC Exposure for Aquatic Invertebrates at Janes and Hutchinson Ravines . . . . .	8-14
Table 8-4	Ecotoxicity Quotients for Evaluation of Sediment EcoCOPC Ingestion by Raccoons at Janes and Hutchinson Ravines . . . . .	8-15
Table 8-5	Ecotoxicity Quotients of EcoCOPCs in <i>L. variegatus</i> By Racoons at Ravines and Beach Areas . . . . .	8-17
Table 8-6	Ecotoxicity Quotients of Ingestion of Surface Water EcoCOPCs by Terrestrial Mammals along the Beach Area . . . . .	8-18
Table 8-7	Ecotoxicity Quotients for Evaluation of Aquatic Invertebrates Exposure to Surface Water EcoCOPC at the Beach Area . . . . .	8-19
Table 8-8	Ecotoxicity Quotients for Evaluation of Sediment EcoCOPC Ingestion by Common Snipe at the Beach Area . . . . .	8-20
Table 8-9	Ecotoxicity Quotients for Evaluation of Ingestion of EcoCOPCs in <i>L.</i> <i>variegatus</i> by Snipes along the Beach Area . . . . .	8-21
Table 8-10	Ecotoxicity Quotients for Evaluation of Sediment EcoCOPC Exposure of Benthic Invertebrates in Lake Michigan . . . . .	8-22
Table 8-11	Total Ecotoxicity Quotients for Snipe at the Beach Area . . . . .	8-23
Table 8-12	Total Ecotoxicity Quotients for Raccoons in Janes Ravine, Hutchinson Ravine, and Beach Area Study Areas . . . . .	8-24
Table 9-1	Summary of Potential Human Health Risks . . . . .	9-3
Table 9-2	Summary of Potential Human Health Risks for Background . . . . .	9-4
Table 9-3	Summary of Potential Risks to Ecological Receptors . . . . .	9-5



**Table of Contents (continued)****List of Figures**

Figure 2-1	Procedure for Background-to-Study Area Inorganic Constituent Comparison .....	2-33
Figure 6-1	Conceptual Model for the Janes and Hutchinson Ravines in the Surplus OU for the Ecological Risk Assessment, Fort Sheridan, Illinois .....	6-7
Figure 6-2	Conceptual Model for the Beach and Lake Areas of the Surplus OU for the Ecological Risk Assessment, Fort Sheridan, Illinois .....	6-8

## **Table of Contents (continued)**

### **List of Appendices**

Appendix A	QA/QC Summary
Appendix B	Data Summary
Appendix C	Background Comparison
Appendix D	Screening Values
Appendix E	Exposure Concentrations
Appendix F	Human Intake Estimation Method and Exposure Factors
Appendix G	Toxicological Profiles
Appendix H	Exposure and Risk Estimates
Appendix I	Risk Tables
Appendix J	Hardness Data Used in Adjusting Surface Water and Groundwater Screening Criteria
Appendix K	Lake Michigan Sediment Sampling

## Table of Contents (continued)

### List of Acronyms and Abbreviations

ANL	Argonne National Laboratory
ANOVA	analysis of variance
ARAR	applicable or relevant and appropriate requirement
atm-m <sup>3</sup> /mole	atmosphere-cubic meters per mole
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BCF	bioconcentration factor
BNA	base neutral acid
BRA	Baseline Risk Assessment
CaCO <sub>3</sub>	calcium carbonate
CFR	Code of Federal Regulations
CO <sub>2</sub>	carbon dioxide
COPC	constituent of potential concern
CSF	cancer slope factors
DoD	Department of Defense
ecoCOPC	ecological constituent of potential concern
E/RfD	exposure level per reference dose
EQs	ecotoxicity quotients
ER-L	effects range-low
ERDEC	Edgewood Research, Development and Engineering Center
FR	Federal Register
FS	feasibility study
FWPCA	Federal Water Pollution Control Act
GAF	gastrointestinal absorption factor
GLH	Great Lakes Harbors
gpm	gallons per minute
g/kg	grams per kilogram
H <sub>2</sub> S	hydrogen sulfide
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
IAC	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
IRDMIS	Installation Restoration Data Management Information System
IRIS	Integrated Risk Information System
JJR	Johnson, Johnson, and Roy, Inc.
JPC	Joint Planning Committee
Kd	soil-water partition coefficient
kg	kilograms
K <sub>oc</sub>	organic carbon partition coefficients
K <sub>ow</sub>	octanol-water partition coefficients
L/day	liters per day
L/kg	liters per kilogram
LC <sub>50</sub>	median lethal concentration

## Table of Contents (continued)

LCFPD	Lake County Forest Preserve District
LD <sub>50</sub>	medial lethal dose
LEC	lower exposure concentration
LF2/SARN	Landfill 2/Small Arms Range North
LOAEL	lowest observed adverse effects level
MCL	maximum contaminant level
MDLs	method detection limits
MEK	methyl ethyl ketone
mg	milligrams
mg/day	milligrams per day
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilogram per day
mL/g	milliliters per gram
mm Hg	millimeters of mercury
μg/g	micrograms per gram
μg/kg	micrograms per kilogram
μg/mg	micrograms per milligram
μg/L	micrograms per liter
μg/mg	micrograms per milligram
NCP	National Contingency Plan
NFG	National Functional Guidelines
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no-observed adverse effect level
OME	Ontario Ministry of the Environment
OQAPP	Overall Quality Assurance Project Plan
OU	Operable Unit
ORNL	Oak Ridge National Laboratory
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
pg/L	picograms per liter
ppb	parts per billion
PRG	preliminary remediation goal
QA/QC	quality assurance/quality control
QC	quality control
RAE	reasonable average exposure
RAGS	Risk Assessment Guidance for Superfund
RBSL	risk-based screening level
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	remedial investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	reasonable maximum exposure
SAS	Statistical Analysis System

**Table of Contents (continued)**

SQC	sediment quality criterion
SSL	Soil Screening Level
SVOC	semi-volatile organic compound
TACO	Tiered Approach to Cleanup Objectives
TAL	target analyte list
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TICs	Tentatively Identified Compounds
TOC	total organic carbon
UCL95	upper 95th percent confidence limit
UF	uncertainty factor
USAEC	U.S. Army Environmental Center
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compounds
WHO	World Health Organization
WoE	weight of evidence
>	greater than
<	less than

**This page left blank intentionally**

## **1.0 Introduction**

This Baseline Risk Assessment (BRA) Report presents the results of the human health and environmental risk evaluation for the ravines and Beach Area study areas of the Surplus Operable Unit (Surplus OU) at Fort Sheridan. This report is based primarily on the information presented in the Remedial Investigation (RI) Report (Volume I). Information concerning background data, site description, site history, previous investigations, and scope of the investigation is provided in detail within the RI.

### **1.1 Purpose of Report**

The purpose of the BRA is twofold. First, the BRA provides an evaluation of the potential threat to human health and the environment associated with the release or potential release of constituents of concern from the ravines and Beach Area study areas of the Surplus OU at Fort Sheridan. The primary objective of this evaluation is to identify constituents of potential concern (COPCs) and exposure pathways, conduct a toxicity assessment for each COPC, conduct an exposure assessment, and characterize potential risks to human and environmental receptors. The BRA summarizes and interprets data collected during the RI to characterize the COPCs, describe constituent migration pathways, identify potential human and environmental exposure pathways, and assess current and future adverse effects on human health and the environment under the no action alternative. The second purpose of the BRA is to evaluate the need for a feasibility study (FS). This evaluation focuses on an evaluation of those potential risks greater than the acceptable range. This analysis will identify those constituents of concern and the affected media that drive the need for an FS.

Reuse scenarios for the Surplus OU are based on the Army-approved Fort Sheridan Joint Planning Committee (JPC) Conceptual Land Use Plan [Johnson, Johnson and Roy, Inc. (JJR), 1997] and with the legislation as adopted in Section 125 of the Fiscal Year 1966 Military Construction Appropriations Act (P.L. 104-32). This legislation requires the Army to convey approximately 290 acres of open space and the existing golf course to the Lake County Forest Preserve District (LCFPD). The Army formally approved the Conceptual Plan with recommendations on February 3, 1995. As a result of the planned reuse of the Landfill 2/Small Arms Range North (LF2/SARN) study area as part of an expanded golf course facility, Hutchinson Ravine, Janes Ravine, and the Beach Area would be expected to provide additional recreational opportunities.

The methods used in conducting this BRA are those presented in the U.S. Environmental Protection Agency (USEPA) Baseline Risk Assessment Guidance for Superfund (RAGS)--Volume I (Human Health Evaluation Manual) and Volume II (Environmental Evaluation Manual) (USEPA, 1989a and 1989b). Other guidance documents used in the preparation of this report include Human Health

Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors" (USEPA, 1991); the USEPA Exposure Factors Handbook (USEPA, 1995a); the USEPA Superfund Exposure Assessment Manual (USEPA, 1988a); and Guidelines for Exposure Assessment (USEPA, 1992a). These and other appropriate technical guidance documents and information sources used in the preparation of this BRA are referenced throughout the report.

## 1.2 Report Organization

This BRA summarizes and interprets data collected during the RI to identify and characterize COPCs; describe constituent exposure pathways and receptors; and assess actual or potential adverse effects on human health and the environment from COPCs present at Janes Ravine, Hutchinson Ravine, and the Beach Area. This BRA report includes several major components:

- Identification of Human COPCs (Section 2.0);
- Exposure Assessment (Section 3.0);
- Toxicity Assessment (Section 4.0);
- Potential Risk Characterization (Section 5.0);
- Problem Formulation for the Ecological Risk Assessment (Section 6.0);
- Exposure and Ecological Effects Analysis (Section 7.0);
- Potential Ecological Risk Characterization (Section 8.0); and
- Conclusions (Section 9.0).

Section 2.0, Identification of Human COPCs, presents a summary of the analytical data for the ravines and Beach Area study areas of the Surplus OU and identifies the COPCs to be evaluated in the BRA. The available data are reviewed for each environmental medium (soils, groundwater, surface water, sediments). For inorganic constituents that may occur naturally, site-related environmental concentrations are compared to available background data to assist in the selection of COPCs.

The Exposure Assessment (Section 3.0) presents the important COPC migration pathways, exposure routes, and estimated COPC intakes for human receptors. The site characteristics affecting the migration of COPCs are discussed first, followed by a description of population demographics and local land/water uses. This information is then combined to develop a conceptual exposure model for the ravines and Beach Area study areas and to select exposure pathways for detailed evaluation. Section 3.0 also presents a series of mathematical exposure equations that are used to quantify exposure to the COPCs by the human receptors for each exposure scenario.

Section 4.0 presents the results of the toxicity assessment. Human toxicity data are presented for the COPCs. Dose-response criteria are identified for both carcinogenic and noncarcinogenic human health effects for each constituent and for each potential exposure route (i.e., oral, inhalation, dermal). The



toxicity assessment also includes a technical summary of the constituents' human and environmental health effects, target organ toxicity data, quantitative toxicity criteria, and other appropriate standards and guidelines.

Section 5.0, Potential Risk Characterization, integrates the information developed in the toxicity assessment and exposure assessment. Potential carcinogenic and noncarcinogenic human health risks are quantified and presented for the COPCs. Potential human health risks are discussed in conjunction with identified uncertainties within the analysis.

Section 6.0 presents an introduction to the ecological risk assessment and problem formulation phase of the ecological risk assessment. Ecological COPCs are identified, an overview of the important study area characteristics is presented, and the scope of the ecological risk analysis is presented. Environmental stressors are characterized, ecosystems potentially at risk are identified, and ecological effects are discussed. This information is combined along with the selection of ecological endpoints to develop a conceptual exposure model for environmental receptors of concern.

Section 7.0 presents the results of the analysis phase of the ecological risk assessment. A discussion is provided for the characterization of stressors and ecosystems as well as full analysis and development of the exposure profile for the ravines and Beach Area study areas.

In Section 8.0, Potential Ecological Risk Characterization, potential exposure concentrations for each environmental medium are compared to ecotoxicity benchmarks. Potential ecological risks are discussed in conjunction with identified uncertainties within the analysis.

The conclusions of the human health and ecological risk assessments are presented in Section 9.0. References for citations throughout the BRA are provided in Section 10.0.

**This page left blank intentionally**

## 2.0 Identification of COPCs

COPCs are subsets of detected constituents that: (1) may be mission-related (i.e., not within normal background levels or present due to laboratory contamination), (2) may pose potential health concerns to humans or ecological receptors, and (3) are selected for further quantitative risk evaluation. The first step in the process by which COPCs are selected is to evaluate the data collection and evaluation procedures. Then, the methodology for selecting site-related COPCs is presented, and the final list of COPCs is chosen.

Because data collection and data evaluation considerations are the same for both the human and ecological risk assessments, both risk assessments are addressed in Sections 2.1 and 2.2. Likewise, the procedures used to compare chemical concentrations in study area samples to background levels are the same for both the human and ecological risk assessments. Thus, the background screening is discussed for both risk assessments in Section 2.3.1. However, the remaining steps of the COPC selection process are unique to the human and ecological risk assessments and are, therefore, discussed separately. COPCs for human receptors only are identified in this section of the BRA, while the COPCs for ecological receptors are presented in Section 7.0.

### 2.1 Site-Specific Data Collection Considerations

The first step in the COPC selection process is to determine which data will be evaluated in the BRA.

#### 2.1.1 Summary of Available Data

Phases I, II, and III of the Surplus OU RI included investigations of numerous study areas or source areas, and various environmental media, including soil, sediment, surface water, groundwater, and biota tissue. The complete data set also includes background sediment, surface water, groundwater, and soil data, as well as quality control (QC) data, including blanks and laboratory spikes. A detailed discussion of the sampling performed during the RI and the results of the sampling are presented in Volume I.

#### 2.1.2 Data Used in the BRA

Not all data collected during the RI were used in this BRA. The following is an explanation of data that were collected within the Surplus OU but not used in the quantitative calculations performed in this BRA:

1. Since the focus of this BRA is Janes Ravine, Hutchinson Ravine, and the Beach Area, only data collected from these study areas were considered.
2. For the human health risk assessment, only sediment and surface water data were considered for purposes of selecting COPCs. Because groundwater in the Surplus OU is not and will not be

used for domestic or industrial purposes due to its poor yield and proximity of a municipal supply, no direct exposure to groundwater is expected to occur and groundwater data are not included in the human risk assessment data set. Evaluation of the hydraulic conductivity and development/presample purging information from the groundwater monitoring wells at Fort Sheridan indicates that the saturated intervals are not capable of a sustainable yield of 10 gallons per minute or 150 gallons per day. Although sand lenses within the glacial till matrix do yield water, the discontinuous nature of these lenses will not allow sustainable yields [Environmental Science & Engineering, Inc. (ESE), 1996a]. There are no potable water supply wells located downgradient from the Surplus OU. All potable water used at Fort Sheridan and the surrounding communities comes from Lake Michigan. Also, analytical data for animal tissue samples are not applicable to the human health risk assessment.

3. For the ecological risk assessment, sediment, surface water, groundwater, and animal tissue [*Lumbriculus variegatus* (*L. variegatus*)] data were considered for purposes of selecting COPCs. Although the majority of groundwater samples were collected from wells in the LF2/SARN study area, groundwater flows from the Surplus OU toward Lake Michigan. Thus, groundwater is considered in the ecological risk assessment.
4. Toxicity characteristic leaching procedure (TCLP) data were not included in the BRA data set as these test results are used to determine if a material can be classified as a hazardous waste and do not provide constituent concentrations upon which to base potential risks.
5. Due to Quality Assurance (QA)/QC concerns (see Volume I, Section 4.0), all Phase I thallium and groundwater data are considered unusable and were not included in the BRA data set.

Summaries of the specific sample identifiers included in each study area evaluated in the human and ecological risk assessments are presented in Tables 2-1 and 2-2, respectively.

## 2.2 General Data Evaluation Considerations

Once the analytical data sets are identified, the next step is to evaluate the data following procedures described in the USEPA Guidance for Data Useability in Risk Assessments (USEPA, 1990). The data evaluation for this BRA considers the following:

- Flagging codes and data qualifiers,
- Tentatively identified compounds (TICs),
- Filtered data,
- Blank contamination, and
- Duplicate samples and multiple analytical methods.

### 2.2.1 Flagging Codes and Data Qualifiers

Data that have been produced by an analytical laboratory may contain flagging codes that are assigned by the U.S. Army Environmental Center (USAEC) in its Installation Restoration Data Management Information System (IRDMIS) to indicate unusual analytical conditions or results. Data qualifiers may also be assigned as part of the independent data validation process conducted pursuant to the National Functional Guidelines (NFG) (USEPA, 1993) to indicate data acceptance or rejection based on the unusual analytical conditions or results. The flagging codes and data qualifiers associated with the BRA data set are defined in the IRDMIS User's Guide (USAEC, 1995) and NFG, and presented in Tables 2-3 and 2-4, respectively. The definitions of the codes and qualifiers and the disposition of flagged/qualified data are also presented in the respective tables.

The target compound list (TCL) is determined by the approved analytical method, in this case the Army method. Numerous chemicals that are not included on the Army TCL are reported during the standard chemical analyses. Data flagged with an "R" indicate that the chemical is not included on the Army TCL and was not detected. However, while use of a relative response factor not based on the individual analyte may result in a concentration that is biased slightly high or low, the identity of the chemical is not in question. Therefore, R-flagged data were used in the quantitative BRA.

Similarly, data flagged with an "S" may indicate that the chemical is not included on the Army TCL but was detected. For some chemicals (e.g., p,p'-DDD), only certain data are flagged with an "S" while other data are not. For these chemicals, the S-flagged data are considered with the unflagged data in the quantitative risk assessment. However, an "S" may also indicate that the chemical is a TIC, in which case the chemical is not included in the final BRA data set. For a discussion of TICs, see Section 2.2.2.

Furthermore, some surrogates were not properly flagged as such in IRDMIS. According to the Overall Quality Assurance Project Plan (OQAPP) (ESE, 1995), 3,4-dinitrotoluene is a surrogate for explosives analysis. Therefore, this chemical is removed from the BRA dataset.

### 2.2.2 Evaluation of TICs

A TIC is a constituent that is not included in the TCL but is reported in a sample. Due to the nature of the detection, both the identity and the concentration of the TIC is typically highly uncertain. TICs are identified in the BRA data set with the flagging code "S" (see Section 2.2.1). According to RAGS (USEPA, 1989a):

*"When only a few TICs are present compared to the target analyte list (TAL) and TCL chemicals, and no historical or other site information indicates that either a particular TIC may indeed be present at the site...or that the estimated concentration may be very high..., then generally do not include the TICs in the risk assessment."*

Although numerous TICs were reported in the BRA data set, these questionable constituents are not included in the quantitative BRA calculations. The majority of the TICs are either straight-chain or methyl-substituted alkanes/alkanoic acids, alcohols, or naturally occurring chemicals (e.g.,  $\gamma$ -sitosterol). Since these constituents do not have USEPA-derived toxicity values and exhibit relatively low toxicity compared to some of the constituents confidently detected at the study areas, these constituents were excluded from the data set to be used in the quantitative BRA.

In addition, although 2,4,5,6-tetrachloro-1,3-xylene was detected in surface water samples from Hutchinson Ravine and was not flagged as a TIC, it is considered as such for the following reason. Each sample was analyzed for constituents on the TCL, and the results are reported as number of hits per number of samples analyzed for the particular constituent. For example, 15 surface water samples from Hutchinson Ravine were analyzed for TCL semi-volatile organic compounds (SVOCs) [e.g., benzo(a)pyrene], and the results are reported as the number of detections per 15 samples [e.g., 1/15 for benzo(a)pyrene]. Because TICs are not target compounds, they are only reported when they are detected. For example, although 15 samples were analyzed for SVOCs, the detection frequency for the TICs 2-propanol and hexadecanoic acid were reported as 3/3 and 1/1, respectively. As 2,4,5,6-tetrachloro-1,3-xylene is not a target compound and has a reported detection frequency in the 15 Hutchinson Ravine surface water samples of 3/3, this constituent is considered a TIC and is not included in the BRA data set.

Summaries of the TICs reported for each study area are presented in Appendix A1.

### 2.2.3 Evaluation of Data from Filtered Samples

Filtered aqueous samples are often collected along with unfiltered samples to provide a perspective on the amounts of detected constituents that are dissolved versus the total amounts in the sample. Because standing surface water available for exposure at the study areas is not filtered, only unfiltered sample data are utilized in the quantitative BRA. For perspective, summaries of the data from filtered samples for each study area are presented in Appendix A2.

### 2.2.4 Blank Contamination

Blank samples provide a measure of contamination that has been introduced into a sample either (1) in the field during sample collection and/or transport to the laboratory or (2) in the laboratory during sample storage, preparation, and/or analysis. To prevent the inclusion of non-mission-related constituents in the BRA, constituent concentrations reported in study area samples are compared to the concentrations of the same constituents detected in associated blanks, including field, trip, rinse, and method blanks.

The rules for comparing chemical concentrations in field samples and blanks differ depending on whether or not the constituent is a common laboratory contaminant. According to RAGS (USEPA, 1989a), the following methodology should be used for blank samples containing common laboratory contaminants:

*"...if the blank contains detectable levels of common laboratory contaminants, then the sample results should be considered as positive results only if the concentrations in the sample exceed ten times the maximum amount detected in any blank. If the concentration of a common laboratory contaminant is less than ten times the blank concentration, then conclude that the chemical was not detected in the particular sample and, in accordance with EPA guidance, consider the blank-related concentrations of the chemicals to be the quantitation limit for the chemical in that sample."*

According to Functional Guidelines for Evaluating Organics (USEPA, 1988b), which is cited in RAGS (USEPA, 1989a), the only constituents considered to be common laboratory contaminants are acetone, methyl ethyl ketone (MEK), methylene chloride, phthalate esters, and toluene. The latest version of USEPA's National Functional Guidelines for Organics Data Review (1993), however, no longer includes toluene as a common laboratory contaminant. Therefore, this constituent is not evaluated as a laboratory contaminant in this BRA.

RAGS also states that the following methodology should be used for blank samples containing constituents other than common laboratory contaminants:

*"...if the blank contains detectable levels of one or more organic or inorganic chemicals that are not considered by EPA to be common laboratory contaminants...then consider site sample results as positive only if the concentration of the chemical in the sample exceeds five times the maximum amount detected in any blank. Treat samples containing less than five times the amount in any blank as non-detects and, in accordance with EPA guidance, consider the blank-related chemical concentration to be the quantitation limit for the chemical in that sample."*

Sample data for each constituent were matched with their corresponding blanks by comparing (1) medium and sample collection date for field, rinse, and trip blanks; and (2) laboratory lot number for method blanks. Based on RAGS (USEPA, 1989a), the data were considered positive only if the concentration detected in the sample exceeded ten times the blank concentration for common laboratory contaminants or five times the blank concentration for constituents that are not considered common laboratory contaminants. When a detected sample concentration was within the five or ten times rule, the detection was requalified to nondetect and the sample concentration was changed to less than the concentration detected in the corresponding blank. For example, if acetone was detected in a sample at 4 micrograms per liter ( $\mu\text{g/L}$ ) and in a corresponding blank at 1  $\mu\text{g/L}$ , the detection of 4  $\mu\text{g/L}$  would be requalified to  $<1 \mu\text{g/L}$ . If a constituent was detected in more than one associated blank sample (e.g., in a field and method blank), the highest detected blank concentration was used for the comparison. The

summary of the data points that fall within five or ten times their corresponding blank concentrations is identical for the human and ecological risk assessments and is presented in Appendix A3.

### **2.2.5 Duplicate Samples and Multiple Analytical Methods**

According to QA/QC protocols, a duplicate sample must be collected for every specified number of samples collected from a particular medium. These duplicates are collected to corroborate the sample collection and analysis methodologies and are not intended to give added “weight” to a particular sample location. To adjust the data for these duplicate samples, the concentrations reported for the primary sample and its duplicate, whether they are detected at or below method detection limits (MDLs), are averaged. The records for the primary sample and the duplicate are then replaced with a single record containing the average concentration. If a particular constituent was detected in one or both of the collected samples, the average concentration is considered as a detection, otherwise the concentration is designated as below the average detection limit.

In addition to duplicate samples, which are analyzed by the same analytical method, a sample may be collected and analyzed using different analytical methods. These multiple analyses are performed because of the different detection limits associated with different analytical methods. Samples are occasionally analyzed by an analytical method with a less sensitive detection limit as a screen for a particular chemical. Then, another analysis may be performed with a more sensitive method to provide a better determination of the actual constituent levels present in the sample. In cases where samples collected from the same location on the same date were analyzed by different methods, the following criteria for sample choice were used:

- If a constituent was detected in both analyses, the maximum detection was used;
- If a constituent was detected in only one of the analyses, the detection was used; and
- If a constituent was not detected in either of the analyses, the minimum detection limit was used.

### **2.2.6 Final BRA Data Sets**

Summaries of the data evaluated in the human and ecological risk assessments by study area resulting from the above data evaluation procedures are presented in Appendices B1 and B2, respectively.

## **2.3 Determination of Site-Specific COPCs**

After the appropriate data sets are determined, site-specific COPCs are chosen. COPCs are the mission-related constituents that may pose the most critical health concerns to humans or ecological receptors. The first step in the determination of COPCs is the comparison to background concentrations.



Because the procedures used to perform the comparison to background concentrations are the same for both the human and ecological risk assessments, this step of the COPC selection process is discussed for both risk assessments in Section 2.3.1. However, because the remaining steps of the COPC selection process are unique to the human and ecological risk assessments, only the selection process for COPCs for human receptors are discussed after the background comparison. These remaining steps are:

- Risk-based screening;
- Nutritional essentiality screening; and
- Retention of screened constituents based on site considerations.

The remaining COPC selection steps for ecological receptors are presented in Section 7.0.

### 2.3.1 Background Comparison

The statistical methodology selected for the study area-to-background area inorganic constituent comparison is based on RAGS (USEPA, 1989a) and Statistical Analysis of Ground-Water Monitoring Data at Resource Conservation and Recovery Act (RCRA) Facilities (USEPA, 1989c; 1992b). The specific methodology is outlined in the Final Revised Final Technical Evaluation Plan (ESE, 1996b). All analyses were conducted using the Statistical Analysis System (SAS®) (1996), a powerful and widely-used statistical software package. Additionally, the analyses conducted are standard statistical methods that can be found in many basic statistical textbooks [e.g., Hollander and Wolfe (1973) for nonparametric methods and Montgomery (1984) for parametric methods]. The primary decision involved is whether to conduct a parametric or nonparametric analysis of variance (ANOVA) based on several criteria to include frequency of detection, normality of the data, and the homogeneity of variances.

A flow chart outlining the procedure for the comparison of background inorganic concentrations to study area inorganic concentrations is presented in Figure 2-1. Only those inorganic analytes for which there was at least one detected concentration in both the background and at least one study area were selected for background analyses. Comparisons were not conducted for the Beach Area samples, as only one background Beach Area sediment sample was available (BLDBSD01). Sample identifiers for the human and background study areas are presented in Tables 2-1 and 2-5, respectively, while sample identifiers for the ecological and background study areas are presented in Tables 2-2 and 2-6, respectively. Results of the human and ecological background comparisons are presented in Tables 2-7 and 2-8, respectively.

Several criteria were required to be met in order to conduct a parametric ANOVA (USEPA, 1989b). The first criterion was to have 15 percent or fewer nondetects in the background and study area(s) (USEPA, 1992b). Second, the data were tested for lognormality using the Shapiro-Wilk test on the natural logarithm-transformed data. If the data were not lognormal, then the Shapiro-Wilk test was applied to the untransformed data. The data needed to be lognormal or normal, as indicated by a Shapiro-Wilk p-value of 0.10 or more. Third, the variances needed to be determined to be homogeneous using Levene's

test for homogeneity of variances, which again was indicated by p-values exceeding 0.10 (USEPA, 1992c). If significant differences were detected by the parametric ANOVA, as indicated by a p-value of 0.10 or less, standard multiple comparison procedures were performed to determine where the significant differences existed (USEPA, 1989b, 1992c).

If any of the criteria for the parametric ANOVA were not met, a nonparametric ANOVA was performed (USEPA, 1989b, 1992c). If the nonparametric ANOVA compares the background concentrations to one study area's concentrations, then it is referred to as the Wilcoxon Rank Sum Test or the Mann-Whitney U Test. If it compares the background concentrations to two or more study areas' concentrations, then it is referred to as the Kruskal-Wallis Test. If significant differences were detected by the nonparametric ANOVA, as indicated by a p-value of 0.10 or less, standard multiple comparison procedures were performed to determine where the significant differences existed (USEPA, 1989b, 1992c; Hollander and Wolfe, 1973). Example calculations are provided in Appendix C. Only constituents detected at concentrations determined to be statistically above background concentrations were carried on to the next step of the human (Section 2.3.2) or ecological (Section 7.0) COPC selection process.

### **2.3.2 Risk-Based Screening**

A risk-based screening was performed to reduce the list of preliminary human receptor COPCs exceeding background concentrations to a more manageable number by comparing the maximum detected concentration to a risk-based screening level (RBSL). The methodologies used to screen analytes in sediment and surface water are discussed in the following sections.

#### **2.3.2.1 Sediment Screening Methodology**

To screen analytes in sediment, the maximum detected constituent concentrations were compared with the lowest of the following RBSLs:

- USEPA Region IX Preliminary Remediation Goals (PRGs) for residential soil (USEPA, 1996a);
- the lesser of the pathway-specific (inhalation, ingestion) USEPA Soil Screening Levels (SSLs) (USEPA, 1996b); and
- the lesser of the pathway-specific (inhalation, ingestion) Illinois EPA (IEPA) Tiered Approach to Corrective Action Objectives (TACO) Tier 1-Residential Exposure Route-Specific Values for Soil (IEPA, 1997).

If any of the above RBSLs were not derived for a particular constituent but a value was available for a similar constituent, the available value was used as a surrogate for the missing value. For example, no PRG has been derived for alpha-chlordane, so the PRG for total chlordane was used as a surrogate.

A list of the constituents detected in sediment and the available PRGs, SSLs, and TACO values are presented in Appendix D1. Results of the risk-based screening for human exposure to sediment are presented in Table 2-9.

Of the 67 compounds confidently detected in beach and/or ravine sediment, the only constituents exceeding RBSLs and evaluated for human exposure further in the BRA are the organochlorine pesticides chlordane, DDD, and DDT; the polynuclear aromatic hydrocarbons (PAHs) benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene; and the metals arsenic, beryllium, and manganese.

### 2.3.2.2 Surface Water Screening Methodology

No risk-based methodology has been developed for Fort Sheridan to screen surface water constituents. In the absence of a medium-specific screening process, the maximum detected surface water concentrations were compared to the lesser of the following RBSLs:

- USEPA Region IX PRGs for groundwater (USEPA, 1996a); and
- 35 Illinois Administrative Code (IAC) Part 620 Class II Groundwater Standards.

While the intermittent surface water present at the study areas is not potable, comparison of surface water concentrations to drinking water screening levels provides the most conservative screening evaluation for human exposure.

If no PRG was derived for a particular analyte but a value was available for a similar analyte, the available PRG was used as a surrogate for the missing value. For example, no PRG has been derived for decachlorobiphenyl A, so the PRG for polychlorinated biphenyl (PCB) 1254 was used as a surrogate.

A list of the constituents detected in surface water and the available or developed PRGs and 35 IAC Part 620 groundwater standards are presented in Appendix D2. Results of the risk-based screening for human exposure to surface water are presented in Table 2-10.

A provisional surface water PRG was developed for one constituent: sulfate. The following formula and exposure factors provided in USEPA Region IX's PRG Guidance (USEPA, 1996a) were used to develop the provisional noncarcinogenic PRG for sulfate:

$$PRG_{gw} (\mu g/L) = \frac{THQ * BW_c * AT_n * CF}{EF_r * ED_c * \frac{IRW_c}{RfD_o}}$$

where:

$AT_n$  = period of time over which noncarcinogenic exposure is averaged,  
 = 6 years  $\times$  365 days/year = 2,190 days.

$BW_c$  = body weight, child = 15 kilograms (kg).

$CF$  = conversion factor = 1,000 micrograms per milligram ( $\mu\text{g}/\text{mg}$ ).

$ED_c$  = exposure duration, child = 6 years.

$EF_r$  = exposure frequency, residential = 350 days/year.

$IRW_c$  = drinking water ingestion rate, child = 1 liter per day (L/day).

$PRG_{gw}$  = preliminary remediation goal for groundwater ( $\mu\text{g}/\text{L}$ ).

$RfDo$  = oral reference dose, constituent-specific [milligrams per kilogram per day ( $\text{mg}/\text{kg}/\text{day}$ )].

$THQ$  = target hazard quotient = 1.

To produce a more conservative provisional groundwater PRG while still keeping within USEPA Region IX PRG methodologies, child exposure factors were used to develop the provisional surface water PRG for sulfate. The oral reference dose (RfD) used to derive the provisional PRG for this constituent and its source are presented in Table 2-11. Surface water PRGs were not calculated for constituents without available toxicity data.

Of the 45 constituents confidently detected in site surface water, the only constituents exceeding RBSLs and evaluated for human exposure further in the BRA are the volatile organic compounds (VOCs) chloroform and chloromethane; the PAHs benzo(a)pyrene and benzo(k)fluoranthene; bis(2-ethylhexyl) phthalate; and the inorganics chloride, manganese, and sulfate.

### 2.3.3 Nutritional Essentiality Screening

According to RAGS (USEPA, 1989a):

*"Constituents that are (1) essential human nutrients, (2) present at low concentrations (i.e., only slightly above naturally occurring levels), and (3) toxic only at very high doses (i.e., much higher than those that could be associated with contact at the site) need not be considered further in the quantitative risk assessment. Examples of such constituents are iron, magnesium, calcium, potassium, and sodium."*

USEPA Region IX does not provide PRGs for any of these essential macronutrients, and no toxicity data are available to develop RfDs for these constituents (USEPA, 1998; 1997a,b; 1996a). Calcium is present in all plant and animal tissues and is a major essential constituent of bones, teeth, and soft tissues. Iron is an essential nutrient for man and is involved in a number of physiologic reactions, including oxygen transport from the lungs to tissues by hemoglobin and oxygen storage in myoglobin. Also, divalent iron is a cofactor in heme enzymes, such as catalase and cytochrome c, and in nonheme enzymes, such as aldolase and tryptophan oxygenase. Magnesium is an essential nutrient for living

organisms because it forms part of the structure of the body and plays a critical role in cell metabolism. In addition, magnesium is an activator of many enzyme systems and is essential for neuromuscular action and muscle contraction. Potassium is also an essential nutrient for muscle contraction, nerve function, cell permeability, intracellular osmotic pressure, and buffering. Sodium is essential for all living organisms. Extracellular functions in humans include osmotic pressure regulation, buffer systems, carbon dioxide (CO<sub>2</sub>) transport, hydration of proteins, cell permeability, and solubilization of organic acids. Intracellular functions include neuromuscular irritability and sodium pump action to regulate the intake of many metabolites. Because calcium, iron, magnesium, potassium, and sodium are essential nutrients and are generally considered to be non-toxic, these chemicals are not considered as preliminary COPCs or evaluated further in the BRA.

Additionally, USEPA Region IV guidance (USEPA, 1996c) states:

*"The only constituents which may be eliminated based on essential nutrients are calcium, chloride, iodine, magnesium, phosphorus, potassium, and sodium."*

Therefore, chloride, which is important in the maintenance of fluid and electrolyte balance and a component of gastric juice, is not considered a preliminary COPC and is not evaluated for human exposure further in the BRA.

#### 2.3.4 Retention of Screened Constituents Based on Site Considerations

RAGS (USEPA, 1989a) guidance requires that a number of factors be assessed following the screening evaluation to ensure that constituents with special properties, though eliminated in the initial screening, are retained on the lists of COPCs. According to this guidance, these special properties may include:

- Historical information--constituents reliably associated with site activities;
- Exceptional toxicity--constituents that are known or potential human carcinogens;
- Mobility, persistence, or bioaccumulation--constituents that are exceptionally mobile, persistent or bioaccumulative, as the screening process does not address these properties;
- Special exposure routes--some constituents with significant exposure routes that are not addressed in the screening process (e.g., dermal absorption);
- Special treatability problems--some constituents are more difficult to treat than others and may be important during the selection of remedial alternatives; and
- Exceedance of potential applicable or relevant and appropriate requirements (ARARs)--constituents exceeding potential constituent-specific ARARs.

According to RAGS (USEPA, 1989a), "It may be practical and conservative to retain a chemical that was detected at low concentrations if that chemical is a Group A carcinogen." Because Group B and C carcinogens have not been definitively determined to be carcinogenic in humans and are screened using a conservative target risk ( $1 \times 10^{-6}$ ), it is not necessary to retain these constituents as COPCs if they do not

exceed the RBSL. Additionally, none of the constituents eliminated during the previous screening steps are known human carcinogens. Therefore, no constituents were retained as COPCs due to carcinogenic potential.

Conversely, constituents may be removed from the list of preliminary COPCs based on site-specific circumstances, such as low frequency of detection. Constituents that are infrequently detected may be anomalies in the data due to sampling or analytical errors and, therefore, may not be site-related (USEPA, 1992a). A detection frequency of 5 percent is suggested as a possible screening level in RAGS (USEPA, 1989a) and has been recommended by USEPA Region VIII (1994a). As frequencies of detection for each detected constituents is greater than 5 percent, no constituents were eliminated from the list of preliminary COPCs based on this criterion.

### **2.3.5 Summary of Site-Specific Human COPCs**

Based on the selection methodology presented in Section 2.3, the human receptor COPCs selected for the Surplus OU beach and ravines include organochlorine pesticides, PAHs, a phthalate, VOCs, and inorganics as presented in Table 2-12.

## **2.4 Summary of Uncertainties Associated with Identification of COPCs**

Uncertainty may be introduced in the BRA during each step of the COPC selection process, as discussed in the following sections.

### **2.4.1 Uncertainties Associated with Data Collection**

A limited number of sediment and surface water samples were collected from the study areas. Therefore, some constituents may be present in these study area media but were not identified due to the limited sampling. Conversely, since the BRA is based on data collected over a broad time period, the possibility exists that some constituents detected in the past are no longer present in ravine sediment and/or surface water.

### **2.4.2 Uncertainties Associated with Data Evaluation**

The use of data with elevated detection limits increases the uncertainty in the evaluation, as constituents may be present at potentially toxic levels but are not detected. To reduce this uncertainty, COPC concentrations reported below detection limits are assumed to be present at one-half of the detection limit.

Use of certain flagged or qualified data also results in some uncertainty. Data flagged with a "J", "K", or "P" indicate uncertainty in the reported concentrations, but not in the identities of the constituents. In

addition, data flagged with an "R" indicate that the chemical is not included on the TCL and was not detected, while data flagged with an "S" may indicate that the chemical is not included on the TCL but was detected. Use of a relative response factor not based on the individual analyte may result in a concentration that is biased slightly high or low. However, the identity of the chemical is not in question. Therefore, use of R- and S-flagged data incorporates some uncertainty. Furthermore, use of Q- and U-flagged data incorporates some uncertainty as the identity of the reported analyte was not confirmed.

Use of K- and L-qualified data also results in some uncertainty as the sample exceeded its prescribed holding time in the laboratory and the reported concentration may be lower than the concentration originally present in the sample due to volatilization or deterioration.

#### **2.4.3 Uncertainties Associated with the COPC Selection Process**

The human health-based screening removes constituents from further consideration in this BRA based primarily on toxicity. However, since constituents may be retained as COPCs based on ARAR exceedance and other chemical-specific factors, the uncertainty associated with the selection process may be reduced.

**This page left blank intentionally**



Table 2-1. Sample Identifiers Included in the Human Health BRA

Study Areas	Medium	Sample Identifier	
Janes Ravine	Sediment	B117SD01	JRBSD02
		B117SD02	JRBSD03
		C-0031	JRSD02
		C-0130	NKASD01
		C-0242	NKASD02
		JRBSD01	
	Surface Water	B117SW01	JRBSW01
		B117SW02	JRBSW02
		C-0031	JRBSW03
		C-0130	JRSW02
		C-0242	
	Sediment	C-0732	HRSD01
		HRBSD01	HRSD02
		HRBSD02	HRSD03
		HRBSD03	LF2SD01
		HRBSD04	LF2SD02
		HRBSD05	
		C-0732	HRSW01
		HRBSW01	HRSW02
		HRBSW02	HRSW03
		HRBSW03	LF2SW01
		HRBSW04	LF2SW02
		HRBSW05	
Beach Area	Sediment	C-0300	LF2SB06D
		C-0690	LF2SB08D
		C-0692	OD-1
		FTRSB01	TRSD01
		FTRSB02	TRSD02
		JRBSD06	
	Surface Water	C-0300	C-0692
		C-0690	OD-1

Source: QST, 1998.

Table 2-2. Sample Identifiers Included in the Ecological BRA

Study Areas	Medium	Sample Identifier		
Janes Ravine	Animal Tissue ( <i>L. variegatus</i> )	JRSBD01		
	Sediment	B117SD01*	JRBSD01	JRSD02
		B117SD02*	JRBSD02	NKASD01*
		C-0031	JRBSD03	NKASD02*
		C-0130		
	Surface Water	B117SW01*	C-0130	JRBSW03
		B117SW02*	JRBSW01	JRSW02
		C-0031	JRBSW02	
Hutchinson Ravine	Animal Tissue ( <i>L. variegatus</i> )	HRBSD01		
	Sediment	C-0732	HRBSD04	HRSD03
		HRBSD01	HRBSD05	LF2SD01
		HRBSD02	HRSD01	LF2SD02
		HRBSD03	HRSD02	
	Surface Water	C-0732	HRBSW04	HRSW03
		HRBSW01	HRBSW05	LF2SW01
		HRBSW02	HRSW01	LF2SW02
		HRBSW03	HRSW02	
Beach Area	Animal Tissue ( <i>L. variegatus</i> )	HRBSD06	JRBSD06	
	Groundwater	LF2MW01	LF2MW06D	LF2MW08S
		LF2MW02	LF2MW06S	LF2MW09D
		LF2MW04D	LF2MW07D	LF2MW09S
		LF2MW04S	LF2MW07S	LF2MW10
		LF2MW05D	LF2MW08D	LF2MW11
		LF2MW05S		
	Sediment	C-0300	FTRSB01	OD-1
		C-0690	FTRSB02	
		C-0692	JRBSD06	
	Surface Water	C-0300	C-0692	
		C-0690	OD-1	

\* Samples were collected from pipes located on the sides of Janes Ravine. Therefore, these samples are qualitatively evaluated separate from the other Janes Ravine samples, which were collected from the bottom of the ravine.

Source: QST, 1998.

Table 2-3. IRDMIS Flagging Codes in the Surplus OU BRA Data Set

Flagging Code	Definition	Data Used In BRA?
8	Analyte recovery exceeds the upper limit of the certified range by less than 15% and the laboratory feels a dilution is not warranted. Old code no longer in use.	Yes
C	Confirmation analysis was performed.	Yes
D	Duplicate analysis (see Section 2.2.5).	Yes
F	Sample filtered prior to analysis (see Section 2.2.3).	No
J	Estimated value; value is below laboratory reporting limits but above the instrument detection limit and indicates uncertainty in the reported concentration but not in its assigned identity. Always used with flagging code "P".	Yes
K	Analyte level is at or near the contract reporting limit or method detection limit and cannot be accurately quantified due to interference.	Yes
L	Sample exceeded its prescribed holding time in the laboratory prior to analysis. This code is no longer used and has been replaced with Data Qualifier "L" (see Table 2-4).	Yes
P	The value is below method reporting limits but above the instrument detection limit and indicates uncertainty in the reported concentration but not in its assigned identity.	Yes
Q	Confirmatory analysis was performed; however, sample interference obscured the area where the peak of interest would have appeared.	Yes
R	Non-target analyte that was analyzed for but not detected. Code used for analytes that were analyzed for using GC/MS methods and were not performance demonstrated or validated.	Yes
S	Non-target analyte that was analyzed for and detected. Code used for analytes that were analyzed for using GC/MS methods and were not performance demonstrated or validated (see Section 2.2.2).	Yes
	Also used for tentatively identified compounds that are quantified against an internal standard (see Section 2.2.2).	No
U	Unconfirmed; a confirmatory analysis was performed but did not verify the results from the initial analysis.	Yes

IRDMIS = Installation Restoration Data Management Information System.

Source: QST, 1998.

Table 2-4. NFG Data Qualifiers in the Surplus OU BRA Data Set

Data Qualifier	Definition	Data Used In BRA?
I	Low spike recovery is high.	Yes
J	Low spike recovery is low.	Yes
K	Sample exceeded its prescribed holding time in the laboratory prior to extraction and preparation. While this code may be important when evaluating the useability of data for volatile organics, which may volatilize from the sample during storage, it is not as important when evaluating semivolatiles and inorganics.	Yes
L	Sample exceeded its prescribed holding time in the laboratory prior to analysis. While this code may be important when evaluating the useability of data for volatile organics, which may volatilize from the sample during storage, it is not as important when evaluating semivolatiles and inorganics.	Yes
M	High spike recovery is high.	Yes
N	High spike recovery is low.	Yes
O	Low spike recoveries are excessively different.	Yes
P	High spike recoveries are excessively different.	Yes
R	Datum is rejected and is not useable.	No

NFG = National Functional Guidelines.

Source: QST, 1998.

Table 2-5. Background Sample Identifiers for Human Health BRA

Background Area	Medium	Sample Identifiers	
Beach Area	Sediment	BLDBSD01	
Ravine	Sediment	BGSD-1	BGSD-4
		BGSD-2	BGSD-5
		BGSD-3	
	Surface Water	BGSW-1	BGSW-4
		BGSW-2	BGSW-5
		BGSW-3	

Source: QST, 1998.

Table 2-6. Background Sample Identifiers for Ecological BRA

Background Area	Medium	Sample Identifiers	
Beach	Animal Tissue ( <i>L. variegatus</i> )	BLDBSD01	
	Groundwater	BGMW01 BGMW02	BGMW03 BGMW04
	Sediment	BLDBSD01	
Ravine	Animal Tissue ( <i>L. variegatus</i> )	JRBSD04	
	Sediment	BGSD-1 BGSD-2 BGSD-3	BGSD-4 BGSD-5
	Surface Water	BGSW-1 BGSW-2 BGSW-3	BGSW-4 BGSW-5

Source: QST, 1998.

Table 2-7. Results of ANOVA Comparing Study Area and Background Concentrations for Human Health BRA\* (Page 1 of 2)

Medium/ Study Area	Analyte	Depth (feet)	Assumed Data Distribution	Are Study Area Concentrations Elevated Above Background? (Alpha=0.1)
<b>Sediment</b>				
Janes Ravine	Aluminum	All	Nonparametric	No
	Arsenic	All	Nonparametric	No
	Barium	All	Nonparametric	No
	Beryllium	All	Nonparametric	No
	Calcium	All	Lognormal	No
	Chromium, total	All	Nonparametric	No
	Cobalt	All	Nonparametric	No
	Copper	All	Nonparametric	No
	Iron	All	Nonparametric	No
	Lead	All	Lognormal	No
	Magnesium	All	Lognormal	No
	Manganese	All	Lognormal	No
	Nickel	All	Lognormal	No
	Potassium	All	Nonparametric	No
	Sodium	All	Nonparametric	No
	Thallium	All	Nonparametric	No
	Vanadium	All	Nonparametric	No
	Zinc	All	Nonparametric	No
Hutchinson Ravine	Aluminum	All	Nonparametric	No
	Arsenic	All	Nonparametric	No
	Barium	All	Nonparametric	No
	Beryllium	All	Nonparametric	No
	Calcium	All	Lognormal	No
	Chromium, total	All	Nonparametric	No
	Cobalt	All	Nonparametric	No
	Copper	All	Nonparametric	No
	Iron	All	Nonparametric	No
	Lead	All	Lognormal	No
	Magnesium	All	Lognormal	No
	Manganese	All	Lognormal	No
	Nickel	All	Lognormal	No
	Potassium	All	Nonparametric	No
	Sodium	All	Nonparametric	No
	Thallium	All	Nonparametric	No
	Vanadium	All	Nonparametric	No
	Zinc	All	Nonparametric	No

Table 2-7. Results of ANOVA Comparing Study Area and Background Concentrations for Human Health BRA\* (Page 2 of 2)

Medium/ Study Area	Analyte	Depth (feet)	Assumed Data Distribution	Are Study Area Concentrations Elevated Above Background? (Alpha = 0.1)
<b>Surface Water</b>				
Janes Ravine	Aluminum	All	Nonparametric	No
	Arsenic	All	Nonparametric	No
	Barium	All	Nonparametric	No
	Calcium	All	Nonparametric	Yes
	Iron	All	Nonparametric	No
	Magnesium	All	Nonparametric	No
	Manganese	All	Nonparametric	Yes
	Potassium	All	Lognormal	No
	Sodium	All	Lognormal	No
Hutchinson Ravine	Aluminum	All	Nonparametric	No
	Arsenic	All	Nonparametric	No
	Barium	All	Nonparametric	No
	Calcium	All	Nonparametric	Yes
	Iron	All	Nonparametric	No
	Magnesium	All	Nonparametric	No
	Manganese	All	Nonparametric	Yes
	Potassium	All	Lognormal	No
	Sodium	All	Lognormal	Yes

ANOVA = analysis of variance.

\* A comparison is performed only for those inorganic constituents that have detections in both study area and background samples for a given depth.

Source: QST, 1998.



Table 2-8. Results of ANOVA Comparing Study Area and Background Concentrations for Ecological BRA\* (Page 1 of 3)

Medium/Study Area	Analyte	Depth (feet)	Assumed Data Distribution	Are Study Area Concentrations Elevated Above Background? (Alpha=0.1)
<b>Groundwater</b>				
<b>Beach</b>	Aluminum	All	Nonparametric	No
	Arsenic	All	Nonparametric	Yes
	Barium	All	Nonparametric	Yes
	Boron	All	Nonparametric	No
	Calcium	All	Nonparametric	Yes
	Chloride	All	Nonparametric	No
	Chromium, total	All	Nonparametric	Yes
	Copper	All	Nonparametric	Yes
	Fluoride	All	Nonparametric	No
	Iron	All	Nonparametric	Yes
	Lead	All	Nonparametric	Yes
	Magnesium	All	Lognormal	No
	Manganese	All	Nonparametric	Yes
	Nickel	All	Nonparametric	Yes
	Nitrogen, NO <sub>2</sub> +NO <sub>3</sub>	All	Nonparametric	No
	Potassium	All	Nonparametric	No
	Sodium	All	Nonparametric	No
	Sulfate	All	Nonparametric	No
	Vanadium	All	Nonparametric	Yes
	Zinc	All	Nonparametric	Yes
<b>Sediment</b>				
<b>Janes Ravine</b>	Aluminum	All	Nonparametric	No
	Arsenic	All	Nonparametric	No
	Barium	All	Nonparametric	No
	Beryllium	All	Nonparametric	No
	Calcium	All	Lognormal	No
	Chromium, total	All	Nonparametric	No
	Cobalt	All	Nonparametric	No
	Copper	All	Nonparametric	No
	Iron	All	Lognormal	No
	Lead	All	Lognormal	No
	Magnesium	All	Lognormal	No
	Manganese	All	Lognormal	No
	Nickel	All	Lognormal	No
	Potassium	All	Nonparametric	No

Table 2-8. Results of ANOVA Comparing Study Area and Background Concentrations for Ecological BRA\* (Page 2 of 3)

Medium/Study Area	Analyte	Depth (feet)	Assumed Data Distribution	Are Study Area Concentrations Elevated Above Background? (Alpha=0.1)
<b>Sediment (cont.)</b>				
Janes Ravine (cont.)	Sodium	All	Nonparametric	No
	Thallium	All	Nonparametric	No
	Vanadium	All	Nonparametric	No
	Zinc	All	Nonparametric	No
Hutchinson Ravine	Aluminum	All	Nonparametric	No
	Arsenic	All	Nonparametric	No
	Barium	All	Nonparametric	No
	Beryllium	All	Nonparametric	No
	Calcium	All	Lognormal	No
	Chromium, total	All	Nonparametric	No
	Cobalt	All	Nonparametric	No
	Copper	All	Nonparametric	No
	Iron	All	Lognormal	No
	Lead	All	Lognormal	No
	Magnesium	All	Lognormal	No
	Manganese	All	Lognormal	No
	Nickel	All	Lognormal	No
	Potassium	All	Nonparametric	No
	Sodium	All	Nonparametric	No
	Thallium	All	Nonparametric	No
	Vanadium	All	Nonparametric	No
	Zinc	All	Nonparametric	No
<b>Surface Water</b>				
Janes Ravine	Aluminum	All	Nonparametric	No
	Arsenic	All	Nonparametric	No
	Barium	All	Nonparametric	No
	Calcium	All	Lognormal	No
	Iron	All	Nonparametric	No
	Magnesium	All	Lognormal	No
	Manganese	All	Nonparametric	Yes
	Potassium	All	Nonparametric	No
	Sodium	All	Lognormal	No

Table 2-8. Results of ANOVA Comparing Study Area and Background Concentrations for Ecological BRA\* (Page 3 of 3)

Medium/Study Area	Analyte	Depth (feet)	Assumed Data Distribution	Are Study Area Concentrations Elevated Above Background? (Alpha=0.1)
<b>Surface Water (cont.)</b>				
Hutchinson Ravine	Aluminum	All	Nonparametric	No
	Arsenic	All	Nonparametric	No
	Barium	All	Nonparametric	No
	Calcium	All	Lognormal	Yes
	Iron	All	Nonparametric	No
	Magnesium	All	Lognormal	No
	Manganese	All	Nonparametric	Yes
	Potassium	All	Nonparametric	No
	Sodium	All	Lognormal	Yes

ANOVA = analysis of variance.

\* A comparison is performed only for those inorganic constituents that have detections in both study area and background samples for a given depth.

Source: QST, 1998.

Table 2-9. Comparison of Maximum Detected Constituents in Sediment to Risk-Based Screening Levels (RBSLs) (Page 1 of 3)

Study Area	Constituent*	Maximum Constituent Concentration Detected in Sediment/Soil (mg/kg)	RBSL† (mg/kg)	Does Maximum Detected Constituent Concentration Exceed RBSL?
Janes Ravine	Acenaphthene	1.78E+00	3.03E+03 <sup>a</sup>	No
	Anthracene	1.29E+00	1.90E+04 <sup>a</sup>	No
	Antimony	9.23E+00	3.07E+01 <sup>a</sup>	No
	Benzo(a)anthracene	2.30E-01	6.09E-01 <sup>a</sup>	No
	Benzo(a)pyrene	3.60E-01	6.09E-02 <sup>a</sup>	Yes
	Benzo(b)fluoranthene	4.30E-01	6.09E-01 <sup>a</sup>	No
	Benzo(g,h,i)perylene	4.10E-01	1.96E+03 <sup>b</sup>	No
	Benzo(k)fluoranthene	2.80E-01	6.09E+00 <sup>a</sup>	No
	Benzoic acid	6.30E-01	2.61E+05 <sup>a</sup>	No
	Bis(2-ethylhexyl)phthalate	2.00E+00	3.17E+01 <sup>a</sup>	No
	Cadmium	9.00E-01	3.83E+01 <sup>a</sup>	No
	Chlordane, alpha-	3.25E-02	3.42E-01 <sup>f</sup>	No
	Chlordane, gamma-	2.85E-02	3.42E-01 <sup>f</sup>	No
	Chlordane, total	5.20E+00	3.42E-01 <sup>a</sup>	Yes
	Chrysene	3.30E-01	6.09E+01 <sup>a</sup>	No
	DDD, p,p'-	6.60E+00	1.85E+00 <sup>a</sup>	Yes
	DDE, p,p'-	4.80E-01	1.31E+00 <sup>a</sup>	No
	DDT, p,p'-	5.90E+00	1.31E+00 <sup>a</sup>	Yes
	Di-n-butyl phthalate	1.00E+01	2.30E+03 <sup>i</sup>	No
	Dibenzo(a,h)anthracene	9.40E-02	6.09E-02 <sup>a</sup>	Yes
	Fluoranthene	6.50E-01	2.61E+03 <sup>a</sup>	No
	Fluorene	2.99E-01	2.47E+03 <sup>a</sup>	No
	Hexachlorocyclohexane, gamma- (Lindane)	7.10E-02	3.42E-01 <sup>a</sup>	No
	Indeno(1,2,3-cd)pyrene	2.40E-01	6.09E-01 <sup>a</sup>	No
	Mercury	2.30E+00	1.00E+01 <sup>h</sup>	No
	Methoxychlor	1.06E-01	3.26E+02 <sup>a</sup>	No
	Methylnaphthalene, 1-	2.58E-01	1.96E+03 <sup>b</sup>	No
	Methylnaphthalene, 2-	8.00E+00	1.96E+03 <sup>b</sup>	No
	Naphthalene	6.87E-01	1.65E+03 <sup>a</sup>	No
	Phenanthrene	3.66E-01	1.96E+03 <sup>b</sup>	No
	Pyrene	1.30E+00	1.96E+03 <sup>a</sup>	No
	Silver	6.30E-01	3.83E+02 <sup>a</sup>	No
	Toluene	1.40E-03	6.50E+02 <sup>i</sup>	No
	Triphenylene	3.15E-01	1.96E+03 <sup>b</sup>	No
	Xylenes, total	1.80E-02	4.10E+02 <sup>j</sup>	No
Hutchinson Ravine	2,4,5-T	2.72E-02	6.52E+02 <sup>a</sup>	No
	Acenaphthene	2.45E+00	3.03E+03 <sup>a</sup>	No
	Acenaphthylene	1.73E+00	1.96E+03 <sup>b</sup>	No
	Aldrin	2.53E-02	2.61E-02 <sup>a</sup>	No
	Anthracene	7.00E+00	1.90E+04 <sup>a</sup>	No
	Antimony	7.88E+00	3.07E+01 <sup>a</sup>	No
	Benzo(a)anthracene	1.00E+01	6.09E-01 <sup>a</sup>	Yes
	Benzo(a)pyrene	8.00E+00	6.09E-02 <sup>a</sup>	Yes
	Benzo(b)fluoranthene	8.00E+00	6.09E-01 <sup>a</sup>	Yes
	Benzo(g,h,i)perylene	4.00E+00	1.96E+03 <sup>b</sup>	No
	Benzo(k)fluoranthene	5.00E+00	6.09E+00 <sup>a</sup>	No
	Bis(2-ethylhexyl)phthalate	2.15E-01	3.17E+01 <sup>a</sup>	No
	Cadmium	5.36E-01	3.83E+01 <sup>a</sup>	No
	Carbazole	2.00E+00	2.22E+01 <sup>a</sup>	No
	Chlordane, alpha-	8.60E-02	3.42E-01 <sup>f</sup>	No

Table 2-9. Comparison of Maximum Detected Constituents in Sediment to Risk-Based Screening Levels (RBSLs) (Page 2 of 3)

Study Area	Constituent*	Maximum Constituent Concentration Detected in Sediment/Soil (ng/kg)	RBSL† (mg/kg)	Does Maximum Detected Constituent Concentration Exceed RBSL?
Beach Area	Chlordane, gamma-	9.44E-02	3.42E-01 <sup>f</sup>	No
	Chlordane, total	9.30E-01	3.42E-01 <sup>a</sup>	Yes
	Chrysene	1.00E+01	6.09E+01 <sup>a</sup>	No
	Cyanide, total	7.83E-01	1.30E+03 <sup>g</sup>	No
	DDD, p,p'-	1.00E+01	1.85E+00 <sup>a</sup>	Yes
	DDE, p,p'-	5.90E-01	1.31E+00 <sup>a</sup>	No
	DDT, p,p'-	9.30E-01	1.31E+00 <sup>a</sup>	No
	Dibenzo(a,h)anthracene	6.00E-01	6.09E-02 <sup>a</sup>	Yes
	Dibenzofuran	2.00E+00	2.61E+02 <sup>a</sup>	No
	Endrin	2.03E-02	1.96E+01 <sup>a</sup>	No
	Fluoranthene	3.00E+01	2.61E+03 <sup>a</sup>	No
	Fluorene	4.00E+00	2.47E+03 <sup>a</sup>	No
	Hexachlorocyclohexane, gamma- (Lindane)	6.28E-03	3.42E-01 <sup>a</sup>	No
	Indeno(1,2,3-cd)pyrene	4.00E+00	6.09E-01 <sup>a</sup>	Yes
	Mercury	2.20E-01	1.00E+01 <sup>h</sup>	No
	Methylnaphthalene, 1-	2.88E+00	1.96E+03 <sup>b</sup>	No
	Methylnaphthalene, 2-	3.69E+00	1.96E+03 <sup>b</sup>	No
	Naphthalene	2.31E+00	1.65E+03 <sup>a</sup>	No
	Phenanthrene	3.00E+01	1.96E+03 <sup>b</sup>	No
	Pyrene	2.00E+01	1.96E+03 <sup>a</sup>	No
	Selenium	2.71E-01	3.83E+02 <sup>a</sup>	No
	Silver	1.05E+00	3.83E+02 <sup>a</sup>	No
	Trichlorofluoromethane	1.20E-02	7.08E+02 <sup>a</sup>	No
	Acenaphthene	2.39E-01	3.03E+03 <sup>a</sup>	No
	Aluminum	6.40E+03	7.67E+04 <sup>a</sup>	No
	Antimony	1.78E+01	3.07E+01 <sup>a</sup>	No
	Arsenic	1.31E+01	3.77E-01 <sup>a</sup>	Yes
	Benzo(a)anthracene	6.11E-03	6.09E-01 <sup>a</sup>	No
	Benzo(a)pyrene	7.21E-03	6.09E-02 <sup>a</sup>	No
	Benzo(b)fluoranthene	8.01E-03	6.09E-01 <sup>a</sup>	No
	Benzo(g,h,i)perylene	9.31E-03	1.96E+03 <sup>b</sup>	No
	Benzo(k)fluoranthene	4.14E-03	6.09E+00 <sup>a</sup>	No
	Beryllium	3.41E-01	1.00E-01 <sup>c</sup>	Yes
	Calcium	1.20E+05	ND <sup>d</sup>	-
	Chlordane, total	1.18E-01	3.42E-01 <sup>a</sup>	No
	Chromium, total	4.68E+00	2.11E+02 <sup>a</sup>	No
	Chrysene	1.36E-02	6.09E+01 <sup>a</sup>	No
	Cobalt	3.51E+00	4.57E+03 <sup>a</sup>	No
	Copper	8.06E+00	2.85E+03 <sup>a</sup>	No
	DDD, p,p'-	4.30E-01	1.85E+00 <sup>a</sup>	No
	DDE, p,p'-	3.50E-02	1.31E+00 <sup>a</sup>	No
	DDT, p,p'-	9.80E-02	1.31E+00 <sup>a</sup>	No
	Dinitrobenzene, 1,3-	2.97E-01	6.52E+00 <sup>a</sup>	No
	Fluoranthene	1.65E-02	2.61E+03 <sup>a</sup>	No
	Hexachlorocyclohexane, gamma- (Lindane)	1.99E-02	3.42E-01 <sup>a</sup>	No
	Indeno(1,2,3-cd)pyrene	4.60E-03	6.09E-01 <sup>a</sup>	No
	Iron	1.30E+04	ND <sup>d</sup>	-
	Lead	1.46E+01	4.00E+02 <sup>c</sup>	No
	Magnesium	5.40E+04	ND <sup>d</sup>	-

Table 2-9. Comparison of Maximum Detected Constituents in Sediment to Risk-Based Screening Levels (RBSLs) (Page 3 of 3)

Study Area	Constituent*	Maximum Constituent Concentration Detected in Sediment/Soil (mg/kg)	RBSL† (mg/kg)	Does Maximum Detected Constituent Concentration Exceed RBSL?
	Manganese	6.27E+02	3.78E+02 <sup>a</sup>	Yes
	Methylnaphthalene, 2-	1.43E-01	1.96E+03 <sup>b</sup>	No
	Nickel	2.78E+01	1.53E+03 <sup>a</sup>	No
	Phenanthrene	5.30E-02	1.96E+03 <sup>b</sup>	No
	Potassium	2.01E+03	ND <sup>d</sup>	--
	Pyrene	2.76E-02	1.95E+03 <sup>a</sup>	No
	Sodium	5.13E+02	ND <sup>d</sup>	--
	Trichlorofluoromethane	1.00E-02	7.08E+02 <sup>a</sup>	No
	Triphenylene	2.92E-01	1.96E+03 <sup>b</sup>	No
	Vanadium	5.90E+01	5.37E+02 <sup>a</sup>	No
	Zinc	1.40E+02	2.30E+04 <sup>c</sup>	No

-- = No comparison is performed due to lack of a risk-based screening level.

mg/kg = milligrams per kilogram

ND = No risk-based screening level determined.

PAH = polynuclear aromatic hydrocarbon

RfD = reference dose

SSL = soil screening level

TACO = Tiered Approach to Cleanup Objectives

- a Provided in USEPA Region IX's Preliminary Remediation Goals (PRGs) (USEPA, 1996a).
- b Surrogate value is the PRG for the most toxic non-naphthalene PAH (pyrene) (USEPA, 1996a).
- c SSL based on ingestion provided in USEPA's Soil Screening Level Guidance (1996b).
- d No PRG developed because the analyte is an essential nutrient.
- e PRG developed from RfD based on acute oral rat LD50 (NIOSH, 1997).
- f Surrogate value is the PRG for total chlordane (USEPA, 1996a).
- g Surrogate value is the PRG for free form cyanide (USEPA, 1996a).
- h TACO value based on inhalation provided in 35 IAC 742, Appendix B, Table A, 2/18/97.
- i SSL based on inhalation provided in USEPA's Soil Screening Level Guidance (USEPA, 1996b).
- j Surrogate value is the inhalation SSL for 1,2-xylene (USEPA, 1996b).

\* Constituents either exceeding background concentrations or not evaluated for background comparison.

† Minimum of the Region IX PRG, SSL, and the TACO value. Applicable screening values for each chemical are presented in Appendix D.

Source: QST, 1998.

Table 2-10. Comparison of Detected Constituent Concentrations in Surface Water to Risk-Based Screening Levels (RBSLs) (Page 1 of 2)

Study Area	Constituent*	Maximum Constituent Concentration Detected in Surface Water (mg/L)	RBSL† (mg/L)	Does Maximum Detected Constituent Concentration Exceed Lowest RBSL?
Janes Ravine	2,4-D	1.41E-03	3.50E-01 <sup>a</sup>	No
	Acetone	1.40E-02	6.08E-01 <sup>c</sup>	No
	Boron	1.49E-01	2.00E+00 <sup>a</sup>	No
	Butylbenzyl phthalate	2.10E-03	7.30E+00 <sup>c</sup>	No
	Calcium	1.11E+02	ND <sup>b</sup>	-
	Chloride	4.80E+02	2.00E+02 <sup>a</sup>	Yes
	Copper	1.19E-02	6.50E-01 <sup>a</sup>	No
	DDD, p,p'-	7.83E-05	2.80E-04 <sup>c</sup>	No
	DDT, p,p'-	1.05E-04	1.98E-04 <sup>c</sup>	No
	Hexachlorocyclohexane, gamma (Lindane)	1.10E-05	5.17E-05 <sup>c</sup>	No
	Lead	6.50E-03	1.50E-02 <sup>d</sup>	No
	Manganese	2.21E-01	1.83E-01 <sup>c</sup>	Yes
	Mercury	3.17E-04	1.00E-02 <sup>a</sup>	No
	Nitrogen, NO2+NO3	6.60E-01	3.65E+00 <sup>e</sup>	No
	Sulfate	1.70E+02	1.78E+02 <sup>f</sup>	No
	Toluene	1.20E-03	7.23E-01 <sup>c</sup>	No
	Triphenylene	4.09E-03	1.10E+00 <sup>h</sup>	No
	Vanadium	1.13E-02	2.56E-01 <sup>c</sup>	No
	Zinc	3.73E-01	1.00E+01 <sup>a</sup>	No
Hutchinson Ravine	Anthracene	9.47E-04	1.83E+00 <sup>c</sup>	No
	Benzo(a)pyrene	1.47E-05	9.20E-06 <sup>c</sup>	Yes
	Benzo(k)fluoranthene	8.80E-06	9.21E-04 <sup>c</sup>	No
	Bis(2-ethylhexyl)phthalate	1.40E-02	4.80E-03 <sup>c</sup>	Yes
	Boron	1.70E-01	2.00E+00 <sup>a</sup>	No
	Butylbenzyl phthalate	3.00E-03	7.30E+00 <sup>c</sup>	No
	Calcium	1.51E+02	ND <sup>b</sup>	-
	Chloride	1.00E+02	2.0E+02 <sup>a</sup>	Yes
	Chloromethane	1.20E-02	1.51E-03 <sup>c</sup>	Yes
	Cyanide, total	5.33E-03	6.00E-01 <sup>a</sup>	No
	DDD, p,p'-	1.10E-04	2.80E-04 <sup>c</sup>	No
	DDE, p,p'-	1.20E-05	1.98E-04 <sup>c</sup>	No
	DDT, p,p'-	2.00E-05	1.98E-04 <sup>c</sup>	No
	Decachlorobiphenyl	3.30E-04	7.30E-04 <sup>e</sup>	No
	Fluoranthene	1.02E-04	1.46E+00 <sup>c</sup>	No
	Fluoride	5.40E-01	2.19E+00 <sup>c</sup>	No
	Hexachlorocyclohexane, gamma- (Lindane)	1.05E-05	5.17E-05 <sup>c</sup>	No
	Lead	7.70E-03	1.50E-02 <sup>d</sup>	No
	Manganese	1.81E+00	1.83E-01 <sup>c</sup>	Yes
	Nitrogen, NO2+NO3	9.20E-01	3.65E+00 <sup>e</sup>	No
	Pyrene	2.80E-04	1.10E+00 <sup>c</sup>	No
	Sodium	5.40E+02	ND <sup>b</sup>	-
	Sulfate	2.00E+02	1.78E+02 <sup>f</sup>	Yes
	Zinc	7.32E-02	1.00E+01 <sup>a</sup>	No
Beach Area	Barium	4.20E-02	2.00E+00 <sup>a</sup>	No
	Calcium	1.30E+02	ND <sup>b</sup>	-
	Chloride	1.20E+02	2.00E+02 <sup>a</sup>	No
	Chloroform	1.60E-03	1.65E-04 <sup>c</sup>	Yes

Table 2-10. Comparison of Detected Constituent Concentrations in Surface Water to Risk-Based Screening Levels (RBSLs) (Page 2 of 2)

Study Area	Constituent*	Maximum Constituent Concentration Detected in Surface Water (mg/L)	RBSL† (mg/L)	Does Maximum Detected Constituent Concentration Exceed Lowest RBSL?
	Iron	9.66E-02	ND <sup>b</sup>	—
	Lead	3.04E-03	1.50E-02 <sup>d</sup>	No
	Magnesium	5.30E+01	ND <sup>b</sup>	—
	Manganese	2.83E-01	1.83E-01 <sup>c</sup>	Yes
	Nitrogen, NO <sub>2</sub> +NO <sub>3</sub>	7.80E-01	3.65E+00 <sup>e</sup>	No
	Potassium	4.04E+01	ND <sup>b</sup>	—
	Sodium	5.09+01	ND <sup>b</sup>	—
	Sulfate	2.69E+02	1.78E+02 <sup>f</sup>	Yes

— = No comparison is performed due to lack of a risk-based concentration.

IAC = Illinois Administrative Code

MCL = maximum contaminant level

mg/L = milligrams per liter

ND = No risk-based concentration determined due to lack of toxicity data.

PAH = polynuclear aromatic hydrocarbon

PRG = preliminary remediation goal

RfD = reference dose

a Illinois Class II Groundwater Standard provided in 35 IAC Part 620.

b No PRG developed because the analyte is an essential nutrient.

c PRG provided in USEPA Region IX's Preliminary Remediation Goals (USEPA, 1996a).

d USEPA drinking water action level for lead in community water supplies (USEPA, 1994a).

e Surrogate value is the PRG for nitrite (USEPA, 1996a).

f PRG developed from RfD based on proposed MCL (USEPA, 1994b).

g Surrogate value is the PRG for PCB 1254 (USEPA, 1996a).

h Surrogate value is the PRG for the most toxic non-naphthalene PAH (pyrene) (USEPA, 1996a).

\* Constituents either exceeding background concentrations or not evaluated for background comparison.

† Minimum of the Region IX PRG, SSL, and the TACO value. Screening values are presented in Appendix C.

Source: QST, 1998.



Table 2-11. Basis for Developed PRGs

Analyte	RfD Used to Developed PRG (mg/kg/day)	Uncertainty Factor		
		Value	Source	RfD Source
Sulfate	11.4	NA	NA	400 mg/L [proposed MCL (USEPA, 1994b)] times 2 L/day/70 kg

MCL = maximum contaminant level

mg/kg/day = milligrams per kilogram per day.

NA = not applicable

PRG = preliminary remediation goal

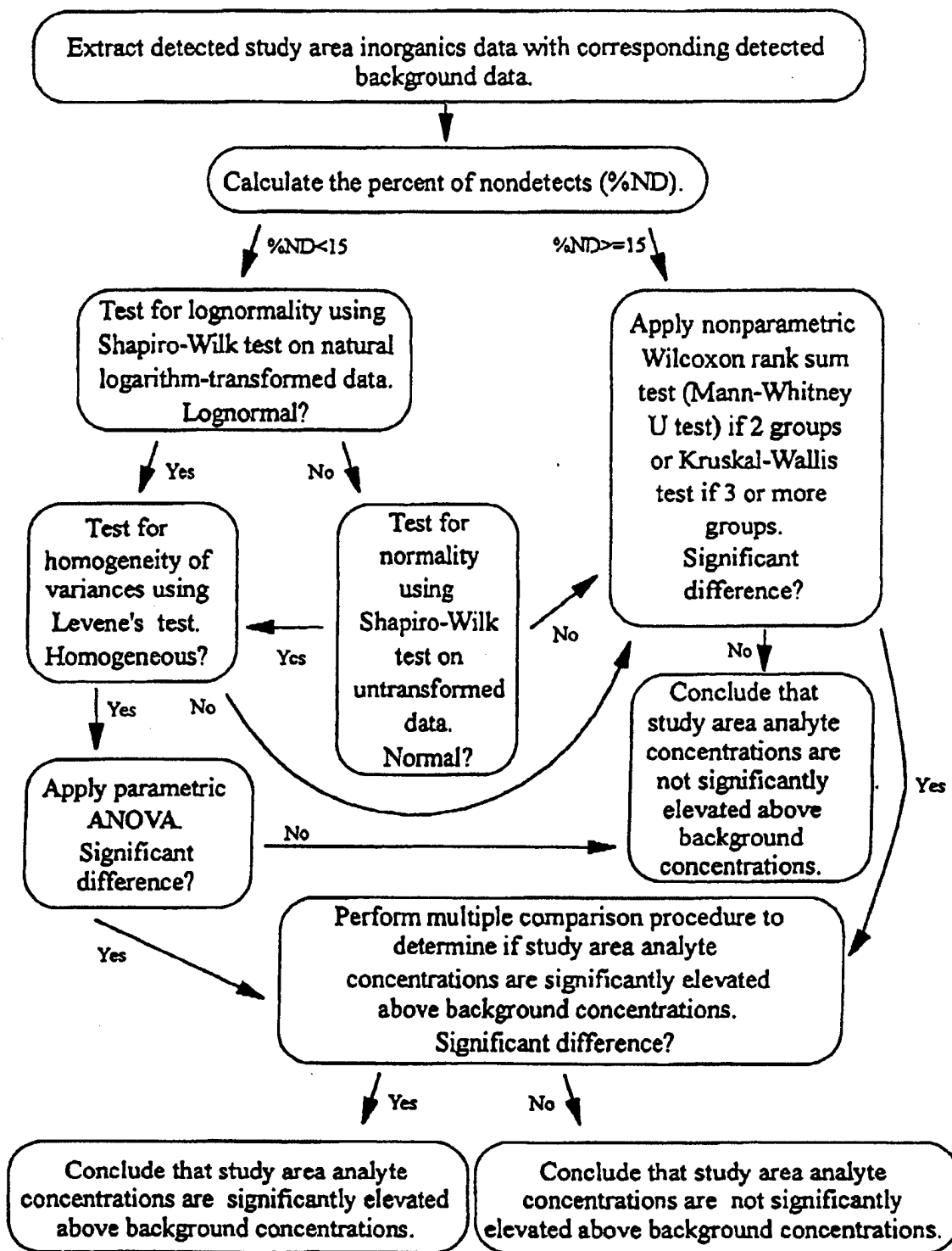
RfD = reference dose

Source: QST, 1998.

Table 2-12. Final Human Health Constituents of Potential Concern (COPCs)

Study Area/Medium	Human Health COPCs	
<b>Janes Ravine</b>		
Sediment	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chlordane	Chrysene DDD, p,p'- DDT, p,p'- Dibenzo(a,h)anthracene Indeno(1,2,3-cd)pyrene
Surface Water	Manganese	
<b>Hutchinson Ravine</b>		
Sediment	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chlordane	Chrysene DDD, p,p' Dibenzo(a,h)anthracene Indeno(1,2,3-cd)pyrene
Surface Water	Benzo(a)pyrene Benzo(k)fluoranthene Bis(2-ethylhexyl)phthalate Chloromethane Manganese Sulfate	
<b>Beach Area</b>		
Sediment	Arsenic Beryllium Manganese	
Surface Water	Chloroform Manganese Sulfate	

Source: QST, 1998.



**Figure 2-1**  
**PROCEDURE FOR BACKGROUND-TO-STUDY AREA**  
**INORGANIC CONSTITUENT COMPARISON**



**This page left blank intentionally**

### **3.0 Exposure Assessment**

The exposure assessment uses the site description and constituent characterization presented in the previous sections to identify potentially exposed human populations, identify actual and potential exposure pathways, and calculate estimated daily intakes of COPCs. Behavioral and physiological factors influencing exposure frequency and levels are presented in a series of exposure scenarios as a basis for quantifying constituent intake levels for each identified exposure pathway. The results of the exposure analysis are applied in the assessment of potential health risks in subsequent sections.

This section incorporates information from each of the preceding sections with site-specific information such as climate, geology, soils, groundwater, surface water, population demographics, land use, water use, agricultural practices, etc. to predict the levels of COPCs to which human receptors would be exposed. Once these exposure levels are determined, they will be compared with the appropriate health effects criteria in Section 4.0 to characterize potential human health risks in Section 5.0.

The approach taken in the actual calculation of exposure levels (Subsection 3.6) is to provide a discussion of each of the exposure routes that has been determined to be potentially significant at the ravines and Beach Area study areas, identify the exposure algorithm, and present the key variables in a tabular format. This approach is intended to assist the reader in understanding the methodology and rationale used in the analysis without burdening the text with numerous calculation tables. However, the rationale for the selection and the full justification for the exposure assumptions used in the calculations are discussed in detail within this section of the BRA.

#### **3.1 Characterization of Exposure Setting**

The physical characteristics of Fort Sheridan that relate to the potential for constituent migration are presented in detail in the RI (Volume I, Section 2.0). Information concerning site physiography, local and regional topography, soils, geology, hydrology, demographics, and climatology are presented in Volume I, Section 2.0 and are not duplicated here. Fort Sheridan and neighboring cities and towns obtain drinking water from Lake Michigan. The nearest town using groundwater as a municipal water supply is Lincolnshire, approximately 5 miles southwest of Fort Sheridan.

#### **3.2 Identification of Potential Exposure Pathways**

This subsection of the exposure assessment uses the characterization of the exposure setting and population data presented in previous subsections to identify potential or suspected exposure pathways at the ravines and Beach Area study areas. The assessment of pathways by which potential human receptors may be exposed to COPCs from the ravines and Beach Area study areas of the Surplus OU

includes an examination of the source, existing migration pathways, and potential exposure routes as well as those that may be reasonably expected in the future. The determination of exposure pathways is made by a careful evaluation of the current extent of affected media at the site in relation to local land and water uses, and the results of a fate and transport assessment that evaluates constituent migration pathways. The exposure pathways are developed only for those COPCs selected in Section 2.0.

### 3.2.1 Source Areas

Site investigations at the ravines and Beach Area study areas have confirmed the presence of COPCs in surface water and sediment. Details of the constituent characterization in surface water and sediment are presented in Section 2.0 of this volume. This BRA will consider each study area separately.

The study areas evaluated in the BRA are:

- Janes Ravine;
- Hutchinson Ravine; and
- Beach Area (including the beach outflow areas from Janes Ravine and Hutchinson Ravine, as well as the intervening beach and the Airport Drain).

### 3.2.2 Fate and Transport Analysis

COPCs present at the ravines and Beach Area study areas may migrate offsite or may remain persistent at the site. Some COPCs, such as the VOCs, are expected to be relatively mobile and may be transported from one environmental medium to another. Other constituents, such as the inorganics, are expected to be less mobile and may remain in the study area for much longer periods of time. The following subsections briefly summarize the fate and transport properties of the COPCs at the ravines and Beach Area study areas.

#### 3.2.2.1 Organic Compounds

Some of the important physical/chemical properties of the organic COPCs detected at the ravines and Beach Area study areas are summarized in Table 3-1. These constituents include VOCs, PAHs, pesticides, and phthalate esters.

##### VOCs

The constituents with vapor pressures greater than 1.0 millimeters of mercury (mm Hg) are generally considered to be fairly volatile. For the ravines and Beach Area study areas, the only constituents in this group are chloroform and chloromethane. These constituents are generally soluble in water and have some of the lower molecular weights of the organic COPCs. The Henry's Law Constant values are greater than  $1.0\text{E-}03$  atmosphere-cubic meters per mole ( $\text{atm}\cdot\text{m}^3/\text{mole}$ ), which indicate that chloroform and chloromethane have a tendency to escape from surface water.

The organic carbon partition coefficients ( $K_{oc}$ ) for chloroform and chloromethane generally range from 6 to 40 milliliters per gram (mL/g) and suggests that these constituents would not be strongly adsorbed by organic materials. The octanol-water partition coefficients ( $\log K_{ow}$ ) range from 0.91 to 1.92 and indicate that these constituents would not be overwhelmingly distributed to the octanol phase. Thus, chloroform and chloromethane would not be expected to accumulate in media or tissues whose physicochemical properties resemble that of octanol, especially in biological systems where removal systems are operative.

Chloroform and chloromethane are water soluble and are expected to be present in solution. Because of their solubility and low  $K_{oc}$  value, chloroform and chloromethane are expected to be quite mobile in the aquatic environment. Biodegradation and volatilization are important fate processes that may affect transport. However, the extent of the control of these processes over migration is expected to be limited because these processes are expected to be slow compared to the rate of groundwater movement.

### **PAHs**

PAHs are an important subgroup of the base neutral acids (BNAs). There are two groups of PAHs detected at the ravines and Beach Area study areas: carcinogenic and noncarcinogenic. However, only the carcinogenic PAHs were selected as COPCs. The carcinogenic PAHs selected are benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Based on the physical and chemical properties summarized in Table 3-1, the carcinogenic PAHs have generally low vapor pressure and water solubilities. Their high organic carbon partition coefficients suggest that adsorption to soils and sediments is an important transport pathway. In addition to adsorption, photolysis is considered the most significant fate process affecting these constituents in the aquatic environment. Volatilization and biodegradation rates are expected to be low for these PAHs.

### **Pesticides**

The pesticides selected as COPCs for the ravines and Beach Area study areas are chlordane, p,p'-DDD, and p,p'-DDT. These constituents generally have the highest molecular weights of the organic compounds and are characterized by low solubilities. The  $K_{oc}$  values for the pesticides are fairly high and suggest that these constituents would be strongly adsorbed by organic materials. The  $\log K_{ow}$  values for the pesticides are also fairly high indicating some potential to accumulate in biological media or tissues whose physicochemical properties resemble that of octanol. Because of these properties, this group of constituents has a tendency to be persistent in the environment (i.e., biodegradation and other removal processes are slow).

### **Bis(2-ethylhexyl)phthalate**

Bis(2-ethylhexyl)phthalate is a member of a group of compounds commonly referred to as the dioctyl phthalates, a group of related phthalate esters. This constituent tends to sorb strongly to soils and

sediments as evidenced by its relatively high  $K_{oc}$  value of  $1.51E+07$  mL/g. Since bis(2-ethylhexyl) phthalate is a relatively nonvolatile constituent, emissions to air are usually less important than releases to other media. Because of its high octanol-water partition coefficient ( $\log K_{ow}$  of 7.3), bis(2-ethylhexyl) phthalate is expected to bioconcentrate in aquatic organisms. Sorption, bioaccumulation, and biodegradation are likely to be competing processes, with the dominant fate being determined by local environmental conditions.

### 3.2.2.2 Inorganic Compounds

Some of the physical/chemical properties of the inorganic COPCs selected for the ravines and Beach Area study areas are presented in Table 3-2. While the pure metallic forms are insoluble in water, many of the salts are soluble in varying degrees. The primary fate process for these inorganics in relation to groundwater is adsorption. These constituents may be released into solution depending on pH, the particular constituent state present, and the presence of aerobic or anaerobic conditions at the site. Values of the soil-water partition coefficient ( $K_d$ ) have been reported to range from 31 to 100,000 liters per kilogram (L/kg) for these inorganic constituents. This suggests that they are likely to be primarily distributed to the soil phase. The important transport and fate characteristics of the inorganic constituents are discussed below.

Arsenic compounds tend to adsorb to soils and sediments. Transport and partitioning of arsenic in water depend upon the constituent form of the arsenic and on interactions with other materials present. Soluble forms may move with water; however, arsenic may be adsorbed onto sediments, especially clays, iron oxides, manganese compounds, and organic material.

Most of the common beryllium compounds are soluble in water. However, soluble beryllium salts are hydrolyzed to form beryllium hydroxide. In most natural environments, beryllium is likely to be present in sorted or precipitated, rather than dissolved, form.

In freshwater systems, manganese can occur as a soluble ion, in complex organic ions, or in colloidal suspensions. In soil, the solubility of manganese is increased at low pH and under reducing conditions. The presence of high concentrations of chlorides, nitrates, or sulfates may also increase solubility.

Sulfate is found almost universally in natural waters in concentrations ranging from a few tenths of a milligram per liter up to several thousand milligrams per liter. Some sulfate is formed during oxidative decay of organic matter. Once sulfate has been dissolved in water, it becomes a permanent solute, except when it is anaerobically reduced to sulfide and precipitated in sediments, released to the atmosphere as hydrogen sulfide ( $H_2S$ ), or incorporated in living organic matter. Most inorganic sulfates are quite soluble except for the lead and barium salts.



### 3.2.3 Constituent Migration Pathways

The affected media at the ravines and Beach Area study areas are limited to surface water and sediment. Although soil and groundwater data were collected from the Surplus OU, these media from a human exposure perspective, are limited to the LF2/SARN study area.

The COPCs at the ravine and Beach Area study areas may potentially migrate toward downgradient receptor locations and may be transported to other environmental media. COPCs in the ravine sediment are expected to remain persistent in the ravines, or may be transported via the following major migration pathways:

- Sediment to groundwater;
- Sediment to surface water; and
- Sediment to air.

COPCs in the surface water may remain persistent in the study areas or may be transported via the following major migration pathways:

- Surface water to groundwater;
- Surface water to sediment; and
- Surface water to air.

Due to the high  $K_{oc}$  values of most of the organics, many of the organic COPCs are expected to be strongly adsorbed to the sediments. As a result, mobility of these organics is expected to be relatively low. Due to the generally low solubilities of the inorganics, significant transport is not expected. However, some of the inorganics may be present in soluble forms that may increase their potential for migration. COPCs in surface water are expected to be easily transported downstream toward to the beach area. COPCs in surface water and sediment at the beach are expected to eventually migrate toward Lake Michigan. The following subsections summarize the potential constituent migration pathways at the ravines and Beach Area study areas at the Surplus OU.

#### **Sediment-to-Groundwater Pathway**

Potentiometric data collected from the Surplus OU indicate that the ravines act as discharge points for the groundwater (i.e., the streams in the bottoms of the various ravines are gaining streams). Although no groundwater wells were installed in either Janes Ravine or Hutchinson Ravine, nested wells installed in Bartlett Ravine (LF5MW04S and LF5MW04D) exhibit a distinct upward gradient. In fact, LF5MW04S is slightly artesian. In addition, the potentiometric contours across the Surplus OU all bend upstream, indicating a component of flow toward the ravines (i.e., indicating discharge to the ravines). None of the potentiometric contours bend downstream as would be expected if the ravines represented losing streams (i.e., indicating flow away from the stream). Consequently, sediment in the ravines is not expected to provide a source of COPCs to groundwater.

### **Sediment-to-Surface Water Pathway**

Typically, when precipitation falls, any surface water runoff may contain some constituents in solution that may be transported along with the surface water to offsite locations. The sediment-to surface water pathway is potentially important when COPCs are present in sediment and may be resuspended in surface water. COPCs have been observed in both surface water and sediment samples collected from Janes Ravine, Hutchinson Ravine, and the Beach Area.

### **Sediment-to-Air Pathway**

The presence of COPCs in sediment samples collected from the ravines and Beach Area study areas could result in a release of these constituents to the atmosphere as dust or vapor. Air monitoring has not been conducted at the Surplus OU to determine the potential for dusts or vapors to be generated from the ravines or Beach Area.

Sediments that have been exposed to natural weathering over a long period of time are likely to have lost the bulk of volatile constituents as a result of volatilization to the atmosphere, leaching, or surface water runoff. No volatile COPCs have been observed in sediments collected from the ravines and Beach Area.

COPCs bound to sediments may be transported as suspended particulates or dust and may migrate when environmental conditions are favorable. Factors influencing the potential for dust entrainment into the atmosphere include surface roughness, surface soil moisture, soil particle size, type and amount of vegetative cover, amount of sediment surface exposed to the eroding wind force, physical and constituent properties of the soil, wind velocity, and other meteorological conditions (USEPA, 1983a). Dust formation could be significant during extended periods of dry weather. However, the affected sediment in the ravines and Beach Area study areas remains moist most of the year. The ravines provide a natural barrier to the eroding wind force, such that wind velocity is greatly reduced within the ravines. Sediments on the beach are more likely to be affected by lake effects (i.e., wave action from Lake Michigan).

### **Surface Water-to-Groundwater Pathway**

Potentiometric data collected from the Surplus OU indicate that the ravines act as discharge points for the groundwater (i.e., the streams in the bottoms of the various ravines are gaining streams). Although no groundwater wells were installed in either Janes Ravine or Hutchinson Ravine, nested wells installed in Bartlett Ravine (LF5MW04S and LF5MW04D) exhibit a distinct upward gradient. In fact, LF5MW04S is slightly artesian. In addition, the potentiometric contours across the Surplus OU all bend upstream, indicating a component of flow toward the ravines (i.e., indicating discharge to the ravines). None of the potentiometric contours bend downstream, as would be expected if the ravines represented losing streams (i.e., indicating flow away from the stream). Consequently, surface water in the ravines is not expected to provide a source of COPCs to groundwater.

### **Surface Water-to-Sediment Pathway**

Just as constituents may partition from sediment to surface water, constituents may also partition from surface water to sediment. Constituents dissolved in surface water may precipitate out of solution and be deposited in the sediment. The surface water to sediment pathway is potentially important when COPCs are present in surface water and may be deposited in sediment. COPCs have been observed in both sediment and surface water samples collected from Janes Ravine, Hutchinson Ravine, and the Beach Area.

### **Surface Water-to-Air Pathway**

Although it is not possible for dusts to be generated from surface water, any volatile COPCs present in surface water may be released to the atmosphere through volatilization. Low concentrations of volatile COPCs have been detected in surface water samples collected from Hutchinson Ravine and the Beach Area. Chloromethane was detected in one out of seven surface water samples collected from Hutchinson Ravine at a concentration of 12  $\mu\text{g/L}$ . Chloroform was detected in one out of four surface water samples collected from the Beach Area at a concentration of 1.6  $\mu\text{g/L}$ . Volatilization from these surface water concentrations is expected to be insignificant.

### **3.2.4 Exposure Routes**

The analysis of exposure to human receptors is a complex process involving the use of numerous exposure assumptions. The assessment of pathways by which human receptors may be exposed to COPCs at the ravines and Beach Area include an examination of existing (current) exposure routes as well as those that may reasonably be expected to occur in the future. The determination of exposure routes is made by a careful examination of the current extent of affected media and the results of the fate and transport assessment for predicting constituent migration pathways and estimating exposure point concentrations.

This subsection lists the potential exposure routes that have been identified for the ravines and Beach Area study areas. A more detailed evaluation of each pathway and the justification for including or excluding specific routes in the detailed quantitative analysis is provided in Section 3.3 (Exposure Pathway Screening).

Potential exposure routes for human receptors at the ravines and Beach Area include:

- Ingestion Pathway--This pathway includes ingestion of any of the affected media (i.e., surface water and sediment);
- Dermal Absorption Pathway--This pathway includes dermal absorption of COPCs from surface water and sediment; and
- Inhalation Pathway--This pathway includes inhalation of dusts (emitted from sediment) and vapors (volatilization from surface water).

### 3.2.5 Conceptual Model

The human health conceptual exposure model for the BRA at the ravines and Beach Area study areas integrates and summarizes the information concerning sources, constituent migration pathways, and exposure routes into a combination of exposure pathways. The conceptual exposure model for the ravines and Beach Area is presented in Table 3-3. This model identifies the key potential release mechanisms, transport media, exposure points, exposure media, exposure routes, and potential receptors for the ravines and Beach Area. Some of the identified potential exposure pathways included in this model are not actually known to be complete pathways (i.e., COPCs are not expected to reach receptors). The model includes all potential exposure pathways and receptors, including some that may not be quantified in this report.

## 3.3 Exposure Pathway Screening

The following subsections present a semi-quantitative screening of the potential exposure pathways associated with the ravines and Beach Area study areas. This screening step identifies those pathways that are complete (i.e., COPCs are expected to reach receptors). For an exposure pathway to be complete, the following four elements must be present:

- A source area or a release from a source;
- A likely environmental migration route (i.e., leaching or partitioning from one medium to another);
- An exposure point where receptors may come into contact with site-related COPCs; and
- An exposure route by which potential receptors may be exposed.

This screening step eliminates from consideration those pathways that are incomplete (i.e., those situations where COPCs may be released, but for which there is little or no potential for contact with receptors). The framework for the selection takes the form of a decision network designed to provide a clear perspective of the relative importance of each potential exposure pathway.

Factors that have been considered in the exposure pathway selection process include:

- Regional importance of site resources;
- Local topography;
- Local land/water use;
- Land re-use planning;
- Qualitative prediction of constituent migration; and
- Persistence and mobility of migrating constituents.

The rationale for the selection of the major routes of exposure through each transport pathway (i.e., surface water, sediment, etc.) is presented in the subsections that follow. The selected pathways will

require detailed quantitative analysis to estimate the potential exposure and associated potential risks at the ravines and Beach Area study areas.

### 3.3.1 Groundwater Pathway

Groundwater generally flows to the east toward Lake Michigan. Groundwater in the vicinity of the ravines is expected to discharge to surface water in the Janes Ravine and Hutchinson Ravine. Groundwater at Fort Sheridan has been classified as Class 2 General Resource Groundwater (ESE, 1996a).

The groundwater at the site is not suitable as a potable water supply. Evaluation of the hydraulic conductivity and development/presample purging information from the groundwater monitoring wells at Fort Sheridan indicates that the saturated intervals are not capable of a sustainable yield of 10 gallons per minute (gpm) to 150 gpm. Although sand lenses within the glacial till matrix do yield water, the discontinuous nature of these lenses will not allow sustainable yields (ESE, 1996a). There are no potable water supply wells located downgradient from the ravines and Beach Area study areas at the Surplus OU. All potable water used at Fort Sheridan and the surrounding communities comes from Lake Michigan. In addition, a local ordinance currently in place for the City of Highwood prohibits the use of groundwater as a potable supply of water. Consequently, the groundwater pathway at the ravines and Beach Area was eliminated as a potential pathway of concern. Potential exposure to surface water and sediment as a result of groundwater discharge is discussed in Sections 3.3.2 and 3.3.3.

### 3.3.2 Surface Water Pathway

Direct exposure to surface water is also an important exposure pathway at the ravines and Beach Area study areas. Human receptors may be exposed to surface water through incidental ingestion and dermal absorption. COPCs have been detected in surface water samples collected from Janes Ravine, Hutchinson Ravine, and the Beach Area. Human receptors that walk or wade through surface water may be potentially exposed through dermal absorption of constituents present in the water. In addition, a receptor may unintentionally ingest small quantities of surface water.

Although surface water runoff may occur during precipitation events, there are no significant signs of erosion that would indicate surface transport of COPCs via the surface water pathway. However, as discussed previously, groundwater discharges to surface water in both Janes Ravine and Hutchinson Ravine. A review of the topography of the natural drainage patterns within the ravine system suggests that groundwater-surface water interaction is very likely. As a result, both current and future exposures to surface water were quantified in this risk assessment. The primary receptors of interest include current and potential future recreational users.

### 3.3.3 Sediment Pathway

Direct exposure to sediment is another important exposure pathway at the ravines and Beach Area study areas. Like surface water, human receptors may be exposed to sediment in Janes Ravine, Hutchinson Ravine, and the Beach Area through incidental ingestion and dermal absorption. COPCs have been detected in sediment samples collected from Janes Ravine, Hutchinson Ravine, and the Beach Area.

Although sediments may be suspended in surface water runoff during precipitation events, there are no significant signs of erosion that would indicate surface transport. However, groundwater discharges to surface water in Janes Ravine and Hutchinson Ravine. While some COPCs are expected to remain dissolved in the surface water, other COPCs are expected to adsorb to sediments in the ravine. Human receptors that walk through these sediments may be potentially exposed through dermal absorption and unintentional ingestion of COPCs present in the sediment. As a result, both current and future exposures to sediment were quantified in this risk assessment. The primary receptors of interest include current and potential future recreational users.

### 3.3.4 Air Pathway

Potential exposures to air are expected to be limited to either dust emissions of COPCs from sediment or vapor emissions of COPCs from surface water. As discussed previously in Section 3.2.3, the potential for dust and vapor emissions from the ravines and Beach Area is very low. Dust formation from sediments in the ravines and Beach Area are not expected to be significant because of generally wet conditions and protection from the eroding force of the wind. Vapor emissions from surface water in the ravines and Beach Area are not expected to be significant because of the low detection frequency and low concentration of volatile COPCs. Future activities in the ravines and Beach Area are not expected to result in human exposure to COPCs in the air. Consequently, the air pathway was eliminated from further consideration.

## 3.4 Receptors of Concern

The preceding discussion identified those pathways that are potentially significant (complete) and those that are included in the detailed quantitative analysis of exposure. The exposure assessment estimates the total intake of COPCs that the key receptor groups are expected to receive over various exposure periods. The key human receptor groups for the ravines and Beach Area study areas are:

- Current Recreational (a golfer); and
- Future Recreational (a golfer or other recreational user, such as a hiker).

Current recreational exposure is expected to be limited to Janes Ravine and Hutchinson Ravine. There is no current exposure at the Beach Area. Current recreational activities in the vicinity of the ravines are

limited to golfing. Since this activity precludes young children, current recreational exposures at Janes Ravine and Hutchinson Ravine are limited to adults (i.e., current exposure to young children is not a viable scenario and is not evaluated for these ravines).

Future recreational activities are expected to occur at Janes Ravine, Hutchinson Ravine, and the Beach Area. Future recreational exposure at the ravines and beach may include both golfing and hiking. Since hiking may include potential exposures to both adults and children, both adults and children are considered significant receptors and are evaluated for the future recreational scenario at Janes Ravine, Hutchinson Ravine, and the Beach Area.

The current conservative linear cancer potency models that the USEPA uses in cancer risk assessments consider the expression of carcinogenic effects to be a function of cumulative dose over a lifetime of exposure. Since a child has a higher ingestion rate and lower body weight compared to an adult, childhood exposures may be greater than those received as an adult. Therefore, carcinogenic exposures were estimated as a time-weighted average which considers the cumulative exposures received as both a child and adult. Noncarcinogenic exposures are calculated for both children and adults; however, exposures to children are expected to be greater because of their lower body weight. Therefore, for purposes of this analysis, future recreational exposures are calculated for both an adult and a child.

### 3.5 Exposure Point Concentrations

In the risk assessment process, potential risk is estimated as a function of exposure with the potential risk of adverse effects increasing as exposure increases. Information on the levels of exposure experienced by different members of the population is key to understanding the range of potential risks that may occur. In order to describe the range of potential risks, both high and central tendency descriptors are used to convey the variability in potential risk levels experienced by different individuals in the population. For purposes of this risk assessment, an estimate of the high end risk descriptor is the reasonable maximum exposure (RME) and the estimate of the central tendency descriptor is the reasonable average exposure (RAE).

An exposure point concentration is the concentration of a COPC in an environmental medium that may reach the potential receptor. The exposure concentration is typically defined as the average concentration contacted at the exposure point. Under USEPA guidance, a conservative estimate of this average concentration is the upper 95th percent confidence limit (UCL95) (USEPA, 1992c). The UCL95 concentration was used as the RME concentration for the ravines and Beach Area study areas. In the event that the UCL95 concentration exceeded the maximum detected concentration at the site, then the maximum detected concentration was used as the RME concentration.

Typically, the central tendency or RAE concentration is the arithmetic mean exposure (average estimate) or the median exposure (median estimate). Since it was not possible to construct true median or mean estimates for all of the factors included in the calculation of exposure, the UCL95 concentration was also used as the best estimate of the RAE concentration for the ravines and Beach Area study areas.

Current recreational exposures at Janes and Hutchinson Ravines were evaluated for surface water and sediment. The current exposure concentrations for surface water and sediment were based on measured concentrations in surface water and sediment of Janes Ravine and Hutchinson Ravine.

Future recreational exposures at Janes Ravine, Hutchinson Ravine, and the Beach Area were also evaluated for surface water and sediment. The future exposure concentration for surface water and sediment were based on measured concentrations in surface water and sediment of Janes Ravine, Hutchinson Ravine, and the Beach Area.

The exposure point concentrations for current and future recreational exposures to surface water at the ravines and Beach Area study areas are presented in Table 3-4. The exposure point concentrations for current and future recreational exposures to sediment are presented in Table 3-5. The exposure point concentrations for exposure to background surface water are presented in Table 3-6. The exposure point concentrations for exposure to background sediment are presented in Table 3-7. The methodology used to calculate exposure concentrations is presented in Appendix E.

### 3.6 Quantification of Pathway-Specific Constituent Intakes

Exposure estimates are calculated for each of the potentially exposed human receptors identified for each exposure pathway selected in the preceding analysis. Generally, the human exposure assumptions for each pathway were selected in accordance with the guidance provided by RAGS (USEPA, 1989a) and the Exposure Factors Handbook (USEPA, 1995a). Receptor intakes were calculated separately for carcinogenic and noncarcinogenic effects.

The degree of potential exposure via each pathway is determined by behavioral, constituent, and physiological factors. Behavioral factors include the amount of time spent in contact with the constituents of concern in soil, water, leachate, surface water, sediment, air, and the volume of material ingested. Constituent factors affecting the degree of exposure relate to the tendency for a compound to be absorbed through the skin as well as the physical state of the constituent in the environment (e.g., solubilized in water). Physiological parameters such as the condition of the skin (i.e., degree of hydration and skin breaks) and the ability of the body to metabolize and eliminate the constituent(s) also determine the amount and type of exposure that may occur. To quantify potential exposures in the risk assessment process, it is necessary to make assumptions regarding each of these factors. These assumptions,



expressed as exposure factors and equations, are presented in Appendix F for each identified complete exposure route.

As discussed previously, potential risk is estimated as a function of exposure, with the potential risk of adverse effects increasing as exposure increases. Information on the levels of exposure experienced by different members of the population is key to understanding the range of potential risks that may occur. In order to describe the range of potential risks, both high end (RME) and central tendency (RAE) estimates of exposure are used to convey the variability in potential risk levels experienced by different individuals in the population.

For each factor involved in the calculation of an exposure estimate, there is a range of values that may describe the magnitude of exposure which may occur to a given individual. In many cases, the state of the science is not yet adequate to define the distributions of all exposure factors that are used in the calculation of the exposure estimates. Consequently, the RME and RAE should be viewed as best approximation of the high end and central tendency exposures, respectively. The RME exposure estimate has been developed using high end values for most of the exposure factors (see Appendix F). Using high end estimates (e.g., above 90th and 95th percentile) for the majority of the exposure variables may result in an estimate of exposure beyond the distribution of actual expected exposure and doses (USEPA, 1995b). Consequently, it is likely that the RME exposure may be over estimated in this report. Because it is not possible to construct a true mean or median estimate (i.e., 50th percentile estimate) for all exposure variables that are included in the exposure algorithms, the RAE was approximated by applying a modifying factor of 5 to the RME estimate. Considering the number of exposure variables, and the potential that most are high end estimates, this is a reasonable approach to estimate the central tendency exposure and is consistent with agency guidance (USEPA, 1995b).

**This page left blank intentionally**

Table 3-1. Physical/Chemical Properties of Organic COPCs

Constituent	Molecular Weight (g/mole)	Water Solubility (mg/L)	Octanol/Water Partition Coefficient (Log $K_{ow}$ )	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m <sup>3</sup> /mole)	Organic Carbon Partition Coefficient ( $K_{oc}$ , mL/g)
Benzo(a)anthracene	228	0.0094	5.7	2.2E-08	3.3E-06	3.98E+05
Benzo(a)pyrene	252	0.00162	6.11	5.6E-09	1.1E-06	1.02E+06
Benzo(b)fluoranthene	252	0.0015	6.2	5.6E-07	1.11E-04	1.23E+06
Benzo(k)fluoranthene	252	0.0008	6.20	5.0E-07	8.29E-07	1.23E+06
Bis(2-ethylhexyl)phthalate	390.6	0.34	7.3	6.2E-08	1.02E-07	1.51E+07
Chlordane	410	0.056	6.32	1.0E-05	4.85E-05	1.2E+05
Chloroform	19.38	7,920	1.92	1.59E+02	3.67E-03	3.98E+01
Chloromethane	50.5	5330	0.91	3.67E+03	8.82E-02	6.3E+00
Chrysene	228	0.0016	5.70	6.3E-09	9.46E-05	3.98E+05
DDD, p,p'-	320	0.09	6.10	1.89E-06	4.00E-06	1.0E+06
DDT, p,p'-	355	0.025	6.53	5.5E-06	8.10E-06	2.63E+06
Dibenzo(a,h)anthracene	278	0.00249	6.69	1.0E-10	1.47E-07	3.8E+06
Indeno(1,2,3-cd)pyrene	276	0.000022	6.65	1.0E-10	1.6E-06	3.47E+06

atm-m<sup>3</sup>/mole = atmosphere-meter cubed per mole

COPC = constituent of potential concern

g/mole = grams per mole

mg/L = milligrams per liter

mL/g = milliliters per gram

mm HG = millimeters of mercury

Sources: HSDB, 1997; IEPA, 1997; and USEPA, 1996b.

Table 3-2. Physical/Chemical Properties of Inorganic COPCs

Constituent	Atomic Weight (g/mole)	Boiling Point (°C)	Melting Point (°C)	Water Solubility (mg/L)	Soil/Water Partition Coefficient (Kd, L/kg)
Arsenic	75	613	817	CS	31
Beryllium	9	2,970	1,290	CS	100,000
Manganese	55	1,962	1,244	CS	65
Sulfate	CS	CS	CS	CS	CS

COPC = constituent of potential concern

CS = constituent specific

°C = degrees centigrade

g/mole = grams per mole

L/kg = liters per kilogram

mg/L = milligrams per liter

Sources: Baes *et al.*, 1984; USEPA, 1985; and IEPA, 1997.

Table 3-3. Conceptual Exposure Model of Potential Exposure Pathways

Affected Media	Release Mechanisms	Transport Media	Exposure Points	Exposure Media/Exposure Routes	Potential Receptors
Sediment	None	Sediment	Ravines and Beach Area	Sediment, ingestion, dermal absorption	Workers, Recreational User
Sediment	Wind erosion, mechanical erosion	Air, dust	Ravines and Beach Area	Inhalation of dust	Workers, Recreational User
Sediment	Volatilization	Air, vapors	Ravines and Beach Area	Inhalation of vapors	Workers, Recreational User
Sediment	Leaching	Groundwater	Ravines and Beach Area	Ingestion, dermal absorption	Workers, Recreational User
Sediment	Sediment to water partitioning	Surface water	Ravines and Beach Area	Ingestion, dermal absorption	Workers, Recreational User
Surface Water	None	Surface water	Ravines and Beach Area	Surface water ingestion, dermal absorption	Workers, Recreational User
Surface Water	Volatilization	Air vapors	Ravines and Beach Area, and Downwind of Site	Inhalation of vapors	Workers, Recreational User
Surface water	Infiltration	Groundwater	Ravines and Beach Area	Ingestion, dermal absorption	Workers, Recreational User
Surface Water	Precipitation; Deposition	Sediment	Ravines and Beach Area	Ingestion, dermal absorption	Workers, Recreational User

Source: QST, 1998.

Table 3-4. Exposure Point Concentrations (mg/L) for Current and Future Recreational Exposure to Surface Water

Constituents of Potential Concern	Distribution	Maximum Detected	Calculated 95% UCL	Selected Exposure Point Concentration
<b>Hutchinson Ravine</b>				
Bis(2-ethylhexyl)phthalate	LN	1.4E-02	3.72E-03	3.72E-03
Benzo(a)pyrene	N	1.47E-05	1.11E-05	1.11E-05
Benzo(k)fluoranthene	LN	8.75E-06	NC	8.75E-06
Chloromethane	LN	1.2E-02	8.54E-03	8.54E-03
Manganese	N	1.81E+00	8.91E-01	8.91E-01
Sulfate	N	2.00+02	1.55+02	1.55E+02
<b>Janes Ravine</b>				
Manganese	N	2.21-01	1.65E-01	1.65E-01
<b>Beach Area</b>				
Chloroform	N	1.60E-03	1.38E-03	1.38E-03
Manganese	N	2.83E-01	2.76E-01	2.76E-01
Sulfate	N	2.69E+02	2.48E+02	2.48E+02

LN = data are lognormally distributed

mg/L = milligrams per liter

N = data are normally distributed

NC = not calculated (too few data points)

UCL = upper confidence limit

Source: QST, 1998.

Table 3-5. Exposure Point Concentrations (mg/kg) for Current and Future Recreational Exposure to Sediment

Constituents of Potential Concern	Distribution	Maximum Detected	Calculated 95% UCL	Selected Exposure Point Concentration
<b>Hutchinson Ravine</b>				
Benzo(a)anthracene	LN	1.00E+01	1.64E+01	1.00E+01
Benzo(a)pyrene	LN	8.00E+00	8.56E+00	8.00E+00
Benzo(b)fluoranthene	LN	8.00E+00	8.52E+00	8.00E+00
Benzo(k)fluoranthene	LN	5.00E+00	6.74E+00	5.00E+00
Chlordane	LN	9.30E-01	7.65E-01	7.65E-01
Chrysene	LN	1.00E+01	1.65E+01	1.00E+01
DDD, p,p'-	LN	1.00E+01	3.44E+01	1.00E+01
Dibenzo(a,h)anthracene	N	6.00E-01	2.70E-01	2.70E-01
Indeno(1,2,3-cd)pyrene	LN	4.00E+00	4.21E+00	4.00E+00
<b>Janes Ravine</b>				
Benzo(a)anthracene	N	2.3E-01	1.23E-01	1.23E-01
Benzo(a)pyrene	N	3.6E-01	1.72E-01	1.72E-01
Benzo(b)fluoranthene	N	4.3E-01	1.93E-01	1.93E-01
Benzo(k)fluoranthene	N	2.8E-01	1.34E-01	1.34E-01
Chlordane	LN	5.20E+00	1.68E+01	5.20E+00
Chrysene	N	3.3E-01	1.47E-01	1.47E-01
DDD, pp'-	LN	6.60E+00	1.21E+04	6.60E+00
DDT, pp'-	LN	5.90E+00	6.70E+02	5.90E+00
Dibenzo(a,h)anthracene	N	9.40E-02	8.55E-02	8.55E-02
Indeno(1,2,3-cd)pyrene	N	2.4E-01	1.35E-01	1.35E-01
<b>Beach Area</b>				
Arsenic	N	1.31E+01	6.85E+00	6.85E+00
Beryllium	N	3.41E-01	2.51E-01	2.51E-01
Manganese	N	6.27E+02	4.68E+02	4.68E+02

LN = Data are lognormally distributed.

mg/L = milligrams per liter

N = Data are normally distributed.

UCL = upper confidence limit

Source: QST, 1998.

Table 3-6. Exposure Point Concentrations (mg/L) for Current and Future Recreational Exposure to Ravine and Beach Area Background Surface Water

Constituents of Potential Concern	Distribution	Maximum Detected	Calculated 95 % UCL	Selected Exposure Point Concentration
<b>Ravines</b>				
Benzo(a)pyrene	--	ND	--	--
Benzo(k)fluoranthene	--	ND	--	--
Bis(2-ethylhexyl)phthalate	N	5.4E-02	2.12E-02	2.12E-02
Chloromethane	--	ND	--	--
Manganese	N	2.18E-01	1.5E-01	1.5E-01
Sulfate	--	ND	--	--
<b>Beach Area</b>				
Chloroform	--	ND	--	--
Manganese	N	2.18E-01	1.5E-01	1.5E-01
Sulfate	--	ND	--	--

mg/L = milligrams per liter

N = data are normally distributed

ND = not detected in background

UCL = upper confidence limit

Source: QST, 1998.



Table 3-7. Exposure Point Concentrations (mg/kg) for Current and Future Recreational Exposure to Ravine and Beach Area Background Sediment

Constituents of Potential Concern	Distribution	Maximum Detected	Calculated 95% UCL	Selected Exposure Point Concentration
<b>Ravines</b>				
Benzo(a)anthracene	N	2.0E+00	1.32E+00	1.32E+00
Benzo(a)pyrene	N	2.0E+00	1.32E+00	1.32E+00
Benzo(b)fluoranthene	N	2.0E+00	1.32E+00	1.32E+00
Benzo(k)fluoranthene	N	1.0E+00	6.96E-01	6.96E-01
Chlordane	N	5.24E-02	4.31E-02	4.31E-02
Chrysene	N	2.0E+00	1.32E+00	1.32E+00
DDD, pp'-	N	2.6E-01	2.12E-01	2.12E-01
DDT, pp'-	N	6.46E-02	5.8E-02	5.80E-02
Dibenzo(a,h)anthracene	--	ND	--	--
Indeno(1,2,3-cd)pyrene	N	1.0E+00	7.09E-01	7.09E-01
<b>Beach Area</b>				
Arsenic	LN*	2.26E+00	NC	2.26E+00
Beryllium	--	ND	--	--
Manganese	LN*	2.26E+02	NC	2.26E+02

\* Assumed distribution (only one sample available).

LN = data are lognormally distributed

mg/kg = milligrams per kilogram

NC = not calculated (only one sample available)

ND = not detected in background

UCL = upper confidence limit

Source: QST, 1998.

**This page left blank intentionally**

## 4.0 Toxicity Assessment

The toxicity assessment weighs the available evidence regarding the potential for a particular constituent to cause adverse effects in exposed individuals and provides an estimate of the extent of exposure and possible severity of adverse effects. The toxicity assessment is performed in two steps: (1) hazard identification and (2) dose-response assessment. The hazard identification determines the potential adverse effects associated with exposure to a constituent along with the types of potential health effects involved. In the dose-response assessment, quantitation of the toxicity values and estimation of reference dose values are performed.

The human health COPCs selected for the Surplus OU are the organochlorine pesticides chlordane, p,p'-DDD, and p,p'-DDT; the PAHs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene; bis(2-ethylhexyl)phthalate; the VOCs chloroform and chloromethane; and the inorganics arsenic, beryllium, manganese, and sulfate. A technical summary of each constituent's human health effects, target organ toxicity data, and quantitative toxicity criteria is provided in Appendix G. Since the majority of the COPCs are well studied, USEPA's Integrated Risk Information System (IRIS) (USEPA, 1998) and Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997a) were the primary information sources used to gather information on pharmacokinetics and human health effects. Cancer slope factors (CSFs) for carcinogenic effects and RfDs for noncarcinogenic effects presented in this section reflect the most current toxicological information available from USEPA (1998; 1997a,b; 1996a) and other sources. These factors are used to estimate potential carcinogenic risk values and noncarcinogenic hazard index (HI) values in the risk characterization.

### 4.1 Evaluation of Potential Carcinogenic Risks

In evaluating potential human health risks, both carcinogenic and noncarcinogenic health effects must be considered. The potential for carcinogenic effects is limited to exposure to certain substances. Therefore, it is necessary to identify and select carcinogenic health criteria only for those COPCs that have evidence of carcinogenicity.

To assess potential human carcinogenic risks, USEPA uses a two-part evaluation: determination of a weight-of-evidence (WoE) classification and calculation of a CSF. The WoE classification is an evaluation of the amount of data available that can be used to classify a constituent as a human carcinogen. Data used to determine the WoE consists of epidemiological data as well as results of animal tests.

Generally, a CSF is a plausible upperbound estimate of a response per unit intake of a constituent over a lifetime. Toxicity to carcinogens can be expressed in several ways. The CSF is usually the UCL95 of the slope of the dose-response curve and is expressed as  $(\text{mg/kg/day})^{-1}$ . Toxicity values for carcinogenic effects can also be expressed as risk per unit concentration of the substance in the medium of exposure, referred to as unit risks. The methods used by USEPA to derive CSFs or unit risks are described in RAGS (USEPA, 1989a). For carcinogens, USEPA usually assumes a nonthreshold response. That is, at every dose level of a carcinogen there is some amount of adverse response. In other words, no dose is believed to be risk-free.

While USEPA currently provides oral and inhalation CSFs for numerous potentially carcinogenic constituents in IRIS (USEPA, 1998) or HEAST (USEPA, 1997a), dermal CSFs have not been derived. However, in RAGS (USEPA, 1989a), USEPA does recommend developing dermal CSFs and provides methodology to calculate these values from oral CSFs. Since the majority of oral CSFs are based on the administered dose of a constituent and the dermal exposure equation results in an absorbed dose, it is necessary to convert the oral CSF from an administered to an absorbed dose. According to RAGS (USEPA, 1989a), a dermal CSF may be calculated by dividing the oral CSF by a gastrointestinal absorption factor (GAF). Chemical-specific GAFs were obtained for the majority of carcinogenic COPCs from toxicological profiles produced by the Agency for Toxic Substances and Disease Registry (ATSDR). In the absence of chemical-specific values, USEPA Region IV (1996c) default values were used.

The potentially carcinogenic COPCs selected for the ravines and Beach Area study areas and their respective CSFs, WoE classifications, and GAFs are presented in Table 4-1.

The majority of the COPCs are either known, probable, or possible human carcinogens. Of the COPCs, USEPA has classified arsenic as a Group A human carcinogen; bis(2-ethylhexyl)phthalate, chlordane, chloroform, p,p'-DDD, p,p'-DDT, all of the PAHs, and beryllium as Group B2 probable human carcinogens; and chloromethane as a Group C possible human carcinogen. Oral and inhalation CSFs are provided for all of the carcinogenic COPCs (USEPA, 1998; 1997a,b; 1996a).

## 4.2 Evaluation of Noncarcinogenic Effects

Excessive exposure to any chemical constituent may potentially produce noncarcinogenic health effects. Therefore, it is necessary to identify and select noncarcinogenic health criteria for each COPC to be evaluated in the BRA, including potential carcinogens.

#### 4.2.1 Toxicity Information for Noncarcinogenic Effects

An RfD is an estimate (with uncertainty spanning approximately an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects if experienced continuously during a lifetime and is the toxicity value most often used to evaluate the noncarcinogenic effects from exposure to constituents. RfDs are specific to the route of exposure (i.e., an inhalation RfD is used for inhalation exposure), critical effect (developmental or systemic), and the length of exposure evaluated. Chronic RfDs are specifically developed to be protective against long-term exposure to a constituent. Subchronic RfDs are developed to characterize potential noncarcinogenic effects associated with shorter-term exposures. The derivation procedure for an RfD can be found in RAGS (USEPA, 1989a) or other technical guidance documents for criteria development. The concentrations of evaluated constituents detected in environmental media, the exposure scenarios, and the potential completed exposure routes evaluated are more relevant to a chronic exposure scenario. Therefore, only chronic toxicity receptors were evaluated.

USEPA currently provides only oral and inhalation RfDs for numerous constituents and does not derive dermal RfDs. Similar to the oral-to-dermal CSF conversion, it is necessary to convert the oral RfD from an administered to an absorbed basis (USEPA, 1989a). To calculate a dermal RfD, the oral RfD is multiplied by a GAF. Chemical-specific GAFs were obtained for the majority of COPCs from ATSDR toxicological profiles. In the absence of chemical-specific values, USEPA Region IV (1996c) default values were used.

The list of COPCs for the ravines and Beach Area study areas and their respective RfDs and GAFs are presented in Table 4-2. The RfDs listed are the chronic RfDs, as guidance (USEPA, 1989a) requires use of chronic exposure dose (RfD) levels. Chronic RfDs are applicable because: (1) the constituent concentrations typically found at sites are low, and (2) the expected intake rate of constituents is similar to the chronic dose levels administered to experimental animals in chronic toxicity studies. Comparison to the chronic RfDs provides a more conservative evaluation of potential impacts to human health.

#### 4.2.2 Constituents with No Established RfDs

Noncarcinogenic effects were evaluated for each of the selected COPCs, including potentially carcinogenic constituents. The majority of constituents selected as COPCs have oral toxicity values developed by USEPA. Only arsenic, beryllium, and sulfate do not have inhalation RfDs.

No oral RfDs have been developed by USEPA for p,p'-DDD, the PAHs, or sulfate. To evaluate p,p'-DDD, the oral RfD for the parent compound p,p'-DDT was used as a surrogate. To evaluate the potential noncarcinogenic effects of the carcinogenic PAHs, the oral RfD for the most toxic non-naphthalene PAH, pyrene, was used as a surrogate (USEPA, 1996c). It is not appropriate to apply the

RfD for naphthalene to other PAHs because of the differences in the physicochemical and biological properties.

To evaluate exposure to sulfate, an RfD was derived based on the proposed drinking water maximum contaminant level (MCL) of 400 milligrams per liter (mg/L) (USEPA, 1994b) and assuming that a healthy 70-kg adult ingests 2 L/day of water. Because the derived oral RfD is based on direct gastrointestinal effects, it is not appropriate to develop a dermal RfD based on the MCL.

### 4.3 Uncertainties Related to Toxicity Information

The quantitative uncertainty factor (UF) associated with each human toxicity value is listed in Table 4-2. The greater the UF, the greater the uncertainty behind applicability of the value to the environmental exposure conditions. Also, use of surrogate values may over- or underestimate potential risks. In addition, although the method used for developing CSFs assumes a nonthreshold approach, experimental evidence indicates that some of the potential carcinogens have dose-response curves that suggest a response threshold.

The oral RfD for manganese in soil and water of 0.047 mg/kg/day (USEPA, 1998) is based on a no-observed adverse effect level (NOAEL) of 10 milligrams per day (mg/day). IRIS (USEPA, 1998) states, "In applying the reference dose for manganese to a risk assessment, it is important that the assessor consider the ubiquitous nature of manganese, specifically that most individuals will be consuming about 2 to 5 milligrams (mg) of manganese per day in their diet. This is particularly important when one is using the reference dose to determine acceptable concentrations of manganese in water and soils. Thus, according to IRIS, up to 50 percent of the acceptable manganese intake will be consumed in the diet, and it would be conservative to base the RfD for ingested environmental media (e.g., sediment) on the actual acceptable manganese intake from those non-food sources (5 mg/day). Use of the unadjusted RfD provides a less conservative evaluation and may allow for excess manganese exposure.

The chemical-specific GAFs chosen for the COPCs are typically the minimum value of a range, resulting in a more conservative dermal CSF or RfD. In the absence of chemical-specific values or default values from IEPA or USEPA Region V, a default GAF [specific to a chemical group (i.e., volatile organics, semi-volatile organics, or inorganics)] estimated by USEPA Region IV (1996c) is used. Due to the variability in gastrointestinal absorption, use of the default GAF may underestimate or overestimate potential absorption and result in a more conservative or less conservative dermal CSF/RfD.

Table 4-1. CSFs and Potential Carcinogenic Effects for the Human COPCs (Page 1 of 3)

Chemical	CSF (mg/kg/day) <sup>-1</sup>	WoE* Classification	Type or Site of Cancer	CSF Basis (CSF Source)
<b>Arsenic</b>				
Oral	1.5	A	Human: multiple tumor sites	Drinking water (USEPA, 1998)
Dermal	1.6	A	Human: multiple tumor sites	Oral CSF ÷ GAF of 0.95 (ATSDR, 1993a)
Inhalation	15	A	Human: lung tumors	Inhalation (USEPA, 1998)
<b>Benzo(a)anthracene</b>				
Oral	0.73	B2	Multiple species: total tumors	Based on benzo(a)pyrene (USEPA, 1996a)
Dermal	1.8	B2	Multiple species: total tumors	Oral CSF ÷ GAF of 0.4 (ATSDR, 1995a)
Inhalation	0.73	B2	Hamster: lung tumors	Route extrapolation from benzo(a)pyrene (USEPA, 1996a)
<b>Benzo(a)pyrene</b>				
Oral	7.3	B2	Multiple species: total tumors	Multiple pathways (USEPA, 1998)
Dermal	18	B2	Multiple species: total tumors	Oral CSF ÷ GAF of 0.4 (ATSDR, 1995a)
Inhalation	7.3	B2	Hamster: lung tumors	Route extrapolation (USEPA, 1996a)
<b>Benzo(b)fluoranthene</b>				
Oral	0.73	B2	Multiple species: total tumors	Based on benzo(a)pyrene (USEPA, 1996a)
Dermal	1.8	B2	Multiple species: total tumors	Oral CSF ÷ GAF of 0.4 (ATSDR, 1995a)
Inhalation	0.73	B2	Hamster: lung tumors	Route extrapolation from benzo(a)pyrene (USEPA, 1996a)
<b>Benzo(k)fluoranthene</b>				
Oral	0.073	B2	Multiple species: total tumors	Based on benzo(a)pyrene (USEPA, 1996a)
Dermal	1.8	B2	Multiple species: total tumors	Oral CSF ÷ GAF of 0.4 (ATSDR, 1995a)
Inhalation	0.73	B2	Hamster: lung tumors	Route extrapolation from benzo(a)pyrene (USEPA, 1996a)

Table 4-1. CSFs and Potential Carcinogenic Effects for the Human COPCs (Page 2 of 3)

Chemical	CSF (mg/kg/day) <sup>-1</sup>	WoE* Classification	Type or Site of Cancer	CSF Basis (CSF Source)
<b>Beryllium</b>				
Oral	4.3	B2	Rat: gross tumors	Drinking water (USEPA, 1998)
Dermal	22	B2	Rat: gross tumors	Oral CSF ÷ GAF of 0.2† (USEPA, 1996c)
Inhalation	8.4	B2	Human: lung tumors	Inhalation (USEPA, 1997a)
<b>Bis(2-ethylhexyl)phthalate</b>				
Oral	0.014	B2	Mouse: liver tumors	Diet (USEPA, 1998)
Dermal	0.07	B2	Mouse: liver tumors	Oral CSF ÷ GAF of 0.2 (ATSDR, 1993b)
Inhalation	0.014	B2	Mouse: liver tumors	Route extrapolation (USEPA, 1996a)
<b>Chlordane</b>				
Oral	0.35	B2	Mouse: liver tumors	Diet (USEPA, 1998)
Dermal	0.44	B2	Mouse: liver tumors	Oral CSF ÷ GAF of 0.8 (ATSDR, 1994a)
Inhalation	0.35	B2	Mouse: liver tumors	Diet (USEPA, 1998)
<b>Chloroform</b>				
Oral	0.0061	B2	Rat: kidney tumors	Drinking water (USEPA, 1998)
Dermal	0.0061	B2	Rat: kidney tumors	Oral CSF ÷ GAF of 1.0 (ATSDR, 1995b)
Inhalation	0.081	B2	Mouse: liver tumors	Oral gavage (USEPA, 1997a)
<b>Chloromethane</b>				
Oral	0.013	C	Mouse: kidney tumors	Inhalation (USEPA, 1997a)
Dermal	0.016	C	Mouse: kidney tumors	Oral CSF ÷ GAF of 0.8† (USEPA, 1996c)
Inhalation	0.0063	C	Mouse: kidney tumors	Inhalation (USEPA, 1997a)
<b>Chrysene</b>				
Oral	0.0073	B2	Multiple species: total tumors	Based on benzo(a)pyrene (USEPA, 1996a)
Dermal	0.018	B2	Multiple species: total tumors	Oral CSF ÷ GAF of 0.4 (ATSDR, 1995a)
Inhalation	0.0073	B2	Hamster: lung tumors	Route extrapolation from benzo(a)pyrene (USEPA, 1996a)



Table 4-1. CSFs and Potential Carcinogenic Effects for the Human COPCs (Page 3 of 3)

Chemical	CSF (mg/kg/day) <sup>-1</sup>	WoE* Classification	Type or Site of Cancer	CSF Basis (CSF Source)
<b>DDD, pp'-</b>				
Oral	0.24	B2	Mouse: liver tumors	Diet (USEPA, 1998)
Dermal	0.34	B2	Mouse: liver tumors	Oral CSF ÷ GAF of 0.7 (ATSDR, 1994b)
Inhalation	0.24	B2	Mouse: liver tumors	Route extrapolation (USEPA, 1996a)
<b>DDT, p,p'-</b>				
Oral	0.34	B2	Mouse: liver tumors	Diet (USEPA, 1998)
Dermal	0.49	B2	Mouse: liver tumors	Oral CSF ÷ GAF of 0.7 (ATSDR, 1994b)
Inhalation	0.34	B2	Mouse: liver tumors	Diet (USEPA, 1995a)
<b>Dibenzo(a,h)anthracene</b>				
Oral	7.3	B2	Multiple species: total tumors	Based on benzo(a)pyrene (USEPA, 1996a)
Dermal	18	B2	Multiple species: total tumors	Oral CSF ÷ GAF of 0.4 (ASTDR, 1995a)
Inhalation	7.3	B2	Hamster: lung tumors	Route extrapolation from benzo(a)pyrene (USEPA, 1996a)
<b>Indeno(1,2,3-cd)pyrene</b>				
Oral	0.73	B2	Multiple species: total tumors	Based on benzo(a)pyrene (USEPA, 1996a)
Dermal	1.8	B2	Multiple species: total tumors	Oral CSF ÷ GAF of 0.4 (ASTDR, 1995a)
Inhalation	0.73	B2	Hamster: lung tumors	Route extrapolation from benzo(a)pyrene (USEPA, 1996a)

COPC = constituent of potential concern

CSF = cancer slope factor

GAF = gastrointestinal absorption factor

mg/kg/day = milligrams per kilogram per day

SVOC = semi-volatile organic compound

VOC = volatile organic compound

WoE = weight of evidence

\* Weight-of-evidence to classify the chemical as a human carcinogen.

A = human carcinogen (sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer in humans).

B2 = probable human carcinogen (sufficient evidence of carcinogenicity in animals and inadequate data in humans).

C = possible human carcinogen (limited evidence of carcinogenicity in animals and no data in humans).

† Default gastrointestinal absorption factor (USEPA, 1996c): Inorganics 0.2; SVOCs 0.5; VOCs 0.8

Source: QST, 1998.

Table 4-2. Chronic RfDs and Potential Noncarcinogenic Effects for the COPCs (Page 1 of 3)

Chemical	RfD (mg/kg/day)	Confidence Level	Critical Effect	RfD Basis (RfD Source)	UF <sup>a</sup>
<b>Arsenic</b>					
Oral	0.0003	Medium	Human: skin effects	Drinking water (USEPA, 1998)	3 D,S
Dermal	0.00029	Medium	Human: skin effects	Oral RfD × GAF of 0.95 (ATSDR, 1993a)	3 D,S
Inhalation	--	--	--	--	--
<b>Beryllium</b>					
Oral	0.005	Low	Rat: NOAEL	Drinking water (USEPA, 1998)	100 H,S
Dermal	0.001	Low	Rat: NOAEL	Oral RfD × GAF of 0.2 <sup>b</sup> (USEPA, 1996c)	100 H,S
Inhalation	--	--	--	--	--
<b>Bis(2-ethylhexyl)phthalate</b>					
Oral	0.02	Medium	Guinea pig: increased liver weight	Diet (USEPA, 1998)	1,000 H,L,S
Dermal	0.004	Medium	Guinea pig: increased liver weight	Oral RfD × GAF of 0.2 (ATSDR, 1993b)	1,000 H,L,S
Inhalation	0.022	--	--	Route extrapolation (USEPA, 1996a)	1,000 H,L,S
<b>Chlordane</b>					
Oral	0.0005	Low	Mouse: liver necrosis	Diet (USEPA, 1998)	300 H,S,R
Dermal	0.0004	Low	Mouse: liver necrosis	Oral RfD × GAF of 0.8 (ATSDR, 1994a)	300 H,S,R
Inhalation	0.0005	--	--	Route extrapolation (USEPA, 1996a)	300 H,S,R
<b>Chloroform</b>					
Oral	0.01	Medium	Dog: liver cysts	Oral (USEPA, 1998)	1,000 H,L,S
Dermal	0.01	Medium	Dog: liver cysts	Oral RfD × GAF of 1.0 (ATSDR, 1995b)	1,000 H,L,S
Inhalation	0.01	--	--	Route extrapolation (USEPA, 1996a)	1,000 H,L,S

Table 4-2. Chronic RfDs and Potential Noncarcinogenic Effects for the COPCs (Page 2 of 3)

Chemical	RfD (mg/kg/day)	Confidence Level	Critical Effect	RfD Basis (RfD Source)	UF <sup>a</sup>
<b>Chloromethane</b>					
Oral	0.0036	NA	Human: CNS effects)	Inhalation (USEPA, 1989d)	1,000 H,L,S
Dermal	0.0029	NA	Human: CNS effects	Oral RfD × GAF of 0.8 <sup>b</sup> (USEPA, 1996c)	1,000 H,L,S
Inhalation	0.0036	--	--	Route extrapolation (USEPA, 1996a)	1,000 H,L,S
<b>DDD, p,p'-</b>					
Oral	0.0005 <sup>c</sup>	Medium	Rat: liver lesions	Oral (USEPA, 1998)	100 H,S
Dermal	0.00035 <sup>c</sup>	Medium	Rat: liver lesions	Oral RfD × GAF of 0.7 <sup>c</sup> (ATSDR, 1994b)	100 H,S
Inhalation	0.0005 <sup>c</sup>	--	--	Route extrapolation (USEPA, 1996a)	100 H,S
<b>DDT, p,p'-</b>					
Oral	0.0005	medium	Rat: liver lesions	Oral (USEPA, 1998)	100 H,S
Dermal	0.00035	Medium	Rat: liver lesions	Oral RfD × GAF of 0.7 (USEPA, 1994b)	100 H,S
Inhalation	0.0005	--	--	Route extrapolation (USEPA, 1996a)	100 H,S
<b>Manganese</b>					
Oral	0.047	Medium	Human: CNS effects	Diet (USEPA, 1998)	3(MF) S
Dermal	0.0014	Medium	Human: CNS effects	Oral RfD × GAF of 0.03 (ATSDR, 1992)	3 (MF) S
Inhalation	0.000014 <sup>d</sup>	Medium	Human: CNS effects	Inhalation (USEPA, 1998)	1,000 D,F,L,S
<b>PAHs, carcinogenic</b>					
Oral	0.03 <sup>e</sup>	Low	Mouse: kidney effects	Oral gavage (USEPA, 1998)	3,000 C,D,H,S
Dermal	0.012 <sup>e</sup>	Low	Mouse: kidney effects	Oral RfD × GAF of 0.4 (ATSDR, 1995a)	3,000 C,D,H,S
Inhalation	0.03 <sup>e</sup>	--	--	Route extrapolation (USEPA, 1996a)	3,000 C,D,H,S

Table 4-2. Chronic RfDs and Potential Noncarcinogenic Effects for the COPCs (Page 3 of 3)

Chemical	RfD (mg/kg/day)	Confidence Level	Critical Effect	RfD Basis (RfD Source)	UF <sup>a</sup>
<b>Sulfate</b>					
Oral	1.4 <sup>f</sup>	NA	Human: gastrointestinal effects	Drinking water (USEPA, 1994b)	NA
Dermal	-- <sup>g</sup>	--	--	--	--
Inhalation	--	--	--	--	--

-- = not determined.  
 CNS = central nervous system.  
 COPC = constituent of potential concern  
 GAF = gastrointestinal adsorption factor  
 LOAEL = lowest-observed-adverse-effect level.  
 MCL = USEPA maximum contaminant level.  
 MF = modifying factor.  
 NA = not available.  
 NOAEL = no-observed-adverse-effect level.  
 PAH = polynuclear aromatic hydrocarbon  
 RfD = reference dose.  
 SVOC = semi-volatile organic compound  
 UF = uncertainty factor  
 VOC = volatile organic compound

**a Uncertainty factors:**

- C = to extrapolate from a subchronic study to a chronic endpoint.
- D = to account for deficiencies in the database.
- F = to account for varying toxicity among different forms of the chemical.
- H = to extrapolate from an animal study to humans.
- L = to extrapolate from a LOAEL to a NOAEL.
- R = lack of reproductive effects.
- S = to protect sensitive human subpopulations.
- b Default GAF (USEPA, 1996c): Inorganics 0.2; SVOCs 0.5; VOCs 0.8
- c No RfDs are available for p,p'-DDD; values for the parent compound p,p'-DDT are used as surrogates.
- d Based on an RfC of 5E-5 mg/m<sup>3</sup> (USEPA, 1998) and assumes that a healthy 70-kilogram adult inhales 20 m<sup>3</sup>/day of air.
- e No oral RfDs are available for the carcinogenic PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene]; values for the most toxic non-naphthalene PAH (pyrene) are used as surrogates.
- f Based on the proposed MCL of 400 mg/L (USEPA, 1994b) and assumes that a healthy 70-kilogram adult ingests 2 L/day of water.
- g The oral RfD is based on direct gastrointestinal effects; therefore, it is not appropriate to develop a dermal RfD based on the MCL.

Source: QST, 1998.

## 5.0 Potential Risk Characterization

The objectives of characterizing potential risk are to integrate information developed in the exposure assessment (Section 3.0) and the toxicity assessment (Section 4.0) into a complete evaluation of the current and potential future human health risks associated with COPCs detected in samples collected at the ravines and Beach Area study areas of the Surplus OU. The BRA evaluates the nature and degree of risk to potential human receptor populations described in Section 3.0. Potential risk estimates are derived for individual COPCs and for the total COPC contribution from the ravines and Beach Area to identify the media and COPCs posing the most significant concerns. The results of the risk characterization are used to develop recommendations for remedial action planning. The methods used in the human health risk analysis are those presented in RAGS (USEPA, 1989a), the Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" (USEPA, 1991), and other appropriate USEPA exposure guidance.

Potential human health and environmental risks were determined for each of the exposure pathways described in Section 3.0. The potential human health risks were evaluated separately for noncarcinogenic and carcinogenic effects. Carcinogenic compounds were also evaluated for their noncarcinogenic effects. The potential human health risks were evaluated for the ravines and Beach Area based on the RME and RAE assumptions presented in Sections 3.5 and 3.6.

Following the description of the potential risks associated with human exposure to COPCs at the ravines and Beach Area, the uncertainties associated with the risk analyses are presented. These uncertainties may be attributable to lack of monitoring data, incomplete understanding of the mechanisms involved in constituent transport, assumptions used in exposure assessments, or lack of toxicological information for a particular constituent.

Potential human health risks are presented independently for carcinogenic and noncarcinogenic constituents because of the different toxicological endpoints, relevant exposure durations, and methods employed in characterizing potential risk.

### 5.1 Potential Human Carcinogenic Risks

Incidental potential human health risks associated with exposure to carcinogenic COPCs were calculated based on USEPA's Guidelines for Carcinogenic Risk Assessment (USEPA, 1986a) and Guidelines for

the Health Risk Assessment of Chemical Mixtures (USEPA, 1986b). Potential cancer risks were first calculated for individual COPCs by multiplying exposure levels of each COPC by the appropriate CSF (refer to Section 4.0 for specific CSFs) as follows:

$$Risk = I \times CSF$$

where: Risk = Probability of an individual developing cancer,  
 I = Chronic daily constituent intake averaged over a lifetime of 70 years (mg/kg/day), and  
 CSF = Slope factor, expressed in (mg/kg/day)<sup>-1</sup>

Although estimating potential risk by considering one COPC at a time may significantly underestimate the potential risks associated with simultaneous exposures to several COPCs, the total combined potential health risks were also evaluated for each pathway by summing estimates derived for each COPC for that pathway as follows:

$$Risk_T = \sum Risk_i$$

where: Risk<sub>T</sub> = The total cancer risk, expressed as a unitless probability; and  
 Risk<sub>i</sub> = The risk estimate for the i<sup>th</sup> substance.

The additive approach is in accordance with USEPA guidelines on constituent mixtures in which potential risks associated with carcinogens are considered additive. Thus, risks from inhalation, dermal absorption, and oral exposures can be added to estimate total overall potential risk to human receptors as follows:

$$\begin{aligned} \text{Total Exposure Cancer Risk} &= \text{Risk (exposure pathway 1)} + \text{Risk (exposure pathway 2)} \\ &\quad \dots + \text{Risk (exposure pathway I)} \end{aligned}$$

The site-specific potential carcinogenic risk estimates were based on the RME and RAE exposure factors presented in Section 3.0. To provide a perspective on the potential risks associated with the ravines and Beach Area study areas, the magnitude of the potential cancer risks associated with the known or suspected carcinogens detected at the study areas were compared to the USEPA acceptable cancer risk range of 1.0E-4 to 1.0E-6. Acceptable exposure levels are the residual concentration levels that represent an excess cancer risk to an individual of between 1.0E-4 to 1.0E-6 [55 Federal Register (FR) 8848] based on the dose and response information for the particular constituent. The National Contingency Plan (NCP) has identified an excess upper-bound lifetime cancer risk of 1.0E-6 as the point of departure for determining the need for remediation of constituents that do not have ARARs or for which an ARAR

is not sufficiently protective because of the presence of multiple constituents or multiple pathways of exposure (55 FR 8848).

## 5.2 Potential Human Noncarcinogenic Effects

The measure used to describe the potential for noncarcinogenic toxicity to occur in an individual is not expressed as a probability. The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., the daily dose in mg/kg/day for a long period up to a lifetime) with an RfD derived for a similar period (USEPA, 1989a). This ratio of exposure to toxicity is called a noncarcinogenic HI and is calculated as follows:

$$\text{Noncancer HI} = \frac{E}{\text{RfD}}$$

where: E = Exposure level (or constituent intake averaged over the exposed duration),  
and  
RfD = Reference dose (RfDs are presented in Section 4.0)

The HI assumes that there is a level of exposure (i.e., RfD) below which it is unlikely for even sensitive populations to experience adverse health effects (USEPA, 1989a). If the exposure level exceeds the threshold level [i.e., if the exposure level per reference dose ( $E/\text{RfD}$ ) exceeds unity or  $\text{HI} > 1.0$ ], there may be concern for potential noncarcinogenic effects. As with the carcinogenic constituent evaluation, estimating noncancer hazard potential by considering one COPC at a time may significantly underestimate the potential risks associated with simultaneous exposures for each pathway. By summing estimates derived for each COPC, the total pathway HI is calculated as follows:

$$\text{HI} = \frac{E_1}{\text{RfD}_1} + \frac{E_2}{\text{RfD}_2} + \dots + \frac{E_i}{\text{RfD}_i}$$

where:  $E_i$  = Exposure level (dose for the  $i^{\text{th}}$  constituent,  
 $\text{RfD}_i$  = Reference dose for the  $i^{\text{th}}$  constituent,

This additive approach assumes that multiple subthreshold exposures could result in an adverse effect and that the magnitude of the effect is proportional to the sum of the ratios of the exposure to acceptable exposures. The assumption of additivity is applicable to COPCs that induce the same type of effect. If the HI is greater than unity, COPCs are re-evaluated by critical effect, and separate HIs are calculated by type of effect. The possible effects of multimedia exposures are evaluated by summing the HI values for the relevant exposure routes.

As an HI approaches 10 to 3,000, the uncertainty in the RfD is greatly reduced because of the safety margin incorporated into the RfD (on the order of 10 to 3,000 to account for animal-to-human dose extrapolations and species-to-species differences). Therefore, an HI ranging from 10 to 3,000 not only indicates that chronic effects are posed to potential human receptors, but acute and subchronic effects may also be posed.

Following is a discussion of the calculated potential health risks to human receptors associated with the ravines and Beach Area study areas. The potential risks discussed are specific to the previously presented exposure scenarios.

### 5.3 Site-Specific Potential Risks

The potential site-specific human health risk estimates associated with current and potential future exposure at the ravines and Beach Area are presented in detail in Appendices H and I. A summary of the potential human health risks are presented in the following sections. The potential risks characterized in this section should be reviewed in light of the various associated uncertainties in the analysis as presented in Section 5.5.

#### 5.3.1 Potential Risks Associated with Janes Ravine

Current and future recreational users of Janes Ravine may be potentially exposed to COPCs in surface water and sediment. Exposure may occur through incidental ingestion and dermal absorption of COPCs in surface water and sediment. The total current and future potential noncarcinogenic and carcinogenic risks associated with these human health exposures at Janes Ravine are summarized in Table 5-1.

The total current recreational user (golfer) HIs for the exposure pathways combined range from  $3\text{E-}03$  to  $3\text{E-}02$ . Since the pathway-specific and total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the current recreational scenario at Janes Ravine.

The total current recreational user (golfer) potential carcinogenic risk levels for the pathways combined range from  $4\text{E-}07$  to  $2\text{E-}06$ . Since these cancer risk estimates are lower than or well within the acceptable range ( $1\text{E-}04$  to  $1\text{E-}06$ ), there is no potential unacceptable carcinogenic health risk associated with the current recreational scenario at Janes Ravine.

The total adult and child future recreational user (hiker) potential HIs for the exposure pathways combined range from  $1\text{E-}02$  to  $6\text{E-}02$  and from  $4\text{E-}02$  to  $6\text{E-}01$ , respectively. Since the pathway-specific and total HIs are less than unity, there is no concern for potential noncarcinogenic health effects. The total future recreational user potential carcinogenic health risk levels range from  $1\text{E-}06$  to  $6\text{E-}06$ . Since



each cancer risk estimate is within the acceptable range ( $1\text{E-}04$  to  $1\text{E-}06$ ), there is no potential unacceptable carcinogenic health risk associated with future recreational use of Janes Ravine.

### 5.3.2 Potential Risks Associated with Hutchinson Ravine

Current and future recreational users of Hutchinson Ravine may be potentially exposed to COPCs in surface water and sediment. Exposure may occur through incidental ingestion and dermal absorption of COPCs in surface water and sediment. The total current and future potential noncarcinogenic and carcinogenic risks associated with these human health exposures at Hutchinson Ravine are summarized in Table 5-2.

The total current recreational user (golfer) HIs for the exposure pathways combined range from  $8\text{E-}03$  to  $2\text{E-}02$ . Since the pathway-specific and total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the current recreational scenario at Hutchinson Ravine.

The total current recreational user (golfer) potential carcinogenic risk levels for the pathways combined range from  $4\text{E-}07$  to  $2\text{E-}06$ . Since these cancer risk estimates are lower than or within the acceptable risk range ( $1\text{E-}04$  to  $1\text{E-}06$ ), there is no potential unacceptable carcinogenic health risk associated with the current recreational scenario at Hutchinson Ravine.

The total adult and child future recreational user (hiker) potential HIs for the exposure pathways combined range from  $8\text{E-}03$  to  $4\text{E-}02$  and from  $3\text{E-}02$  to  $1\text{E-}01$ , respectively. Since the pathway-specific and total HIs are less than unity, there is no concern for potential noncarcinogenic health effects. The total future recreational user potential carcinogenic risk levels range from  $5\text{E-}06$  to  $3\text{E-}05$ . Since each cancer risk estimate is well within the acceptable range ( $1\text{E-}04$  to  $1\text{E-}06$ ), there is no potential unacceptable carcinogenic health risk associated with future recreational use of Hutchinson Ravine.

### 5.3.3 Potential Risks Associated with the Beach Area

The Beach Area is currently closed to the public and no current exposure is occurring. Future recreational users of the Beach Area may be potentially exposed to COPCs in surface water and sediment. Exposure may occur through incidental ingestion and dermal absorption of COPCs in surface water and sediment. The total future potential noncarcinogenic and carcinogenic risks associated with these human health exposures at the Beach Area are summarized in Table 5-3.

The total adult and child future recreational user (hiker) potential HIs for the exposure pathways combined range from  $6\text{E-}03$  to  $3\text{E-}02$  and from  $3\text{E-}02$  to  $1\text{E-}01$ , respectively. Since the pathway-specific and total HIs are less than unity, there is no concern for potential noncarcinogenic health effects. The total future recreational user potential carcinogenic risk levels range from  $1\text{E-}06$  to  $5\text{E-}06$ . Since each

cancer risk estimate is well within the acceptable range ( $1E-04$  to  $1E-06$ ), there is no potential unacceptable carcinogenic health risk associated with future recreational use of the Beach Area.

## 5.4 Risk Comparison

A variety of comparisons can be made to provide perspective on the potential risk estimates for the exposure scenarios at the ravines and Beach Area study areas. While the comparison of potential risks is useful to obtain perspective on the magnitude of the problem caused by a study area, risks have a number of qualities beyond magnitude. For example, risk may be voluntary or involuntary, familiar or unfamiliar, controllable or uncontrollable, and the consequences may be dreaded or not, and offset by benefits or not. The best comparisons are those that match as many qualities as possible. For purposes of this report, potential risks associated with background conditions are presented to provide some perspective of the potential risk estimates.

### 5.4.1 Potential Background Risks

The potential carcinogenic and noncarcinogenic human health risk estimates associated with potential exposures to background surface water and sediment are presented in detail in Appendix I. The following sections present a summary of the potential human health risks for background conditions at Fort Sheridan. Potential background risks were estimated only for the same COPCs and exposure pathways selected for the ravines and Beach Area study areas. In addition, the potential background risks characterized in this section are based on the same assumptions regarding exposure that were used to characterize potential risks associated with the ravines and Beach Area presented in Section 3.6 and should be reviewed in light of the various uncertainties presented in Section 5.5. The estimated potential background risks presented in this section are provided for purposes of a relative comparison to the estimated potential risks associated with the ravines and Beach Area.

#### Potential Background Risk Associated with Janes Ravine

The total potential background noncarcinogenic and carcinogenic risks associated with exposure to current and future recreational users at Janes Ravine are summarized in Table 5-4. The total background noncarcinogenic HIs for the current recreational scenario range from  $1E-04$  to  $6E-04$  and equate to approximately 2 percent of the potential noncarcinogenic risk estimate for the current recreational user at Janes Ravine. The total background potential carcinogenic risk levels for the current recreational scenario range from  $3E-08$  to  $2E-07$  and equate to approximately 4 percent of the potential carcinogenic risk estimate for the current recreational scenario at Janes Ravine.

The total background adult and child HIs for the future recreational scenario range from  $4E-04$  to  $2E-03$  and from  $8E-04$  to  $4E-03$ , respectively. These background HIs equate to approximately 10 percent of the potential noncarcinogenic risk estimate for the future adult and child recreational user at Janes Ravine.

The total background potential carcinogenic risk levels for the future recreational user range from  $8\text{E-}07$  to  $4\text{E-}06$  and equate to approximately 70 percent of the potential carcinogenic risk estimate for the future recreational scenario at Janes Ravine.

#### **Potential Background Risks Associated with Hutchinson Ravine**

Current and future recreational users at Fort Sheridan may be exposed to COPCs in background surface water and sediment. Exposures may occur through incidental ingestion and dermal absorption of COPCs in surface water and sediment. The total potential noncarcinogenic and carcinogenic risks associated with these exposures to background conditions at Hutchinson Ravine are summarized in Table 5-5.

The total background noncarcinogenic HIs for the current recreational scenario range from  $8\text{E-}04$  to  $4\text{E-}03$ . These background HIs equate to approximately 3 percent of the potential noncarcinogenic risk estimate for the current recreational user at Hutchinson Ravine. The total background potential carcinogenic risk levels for the current recreational scenario range from  $1\text{E-}07$  to  $5\text{E-}07$ . These background cancer risk estimates equate to approximately 25 percent of the potential carcinogenic risk estimates for the current recreational scenario at Hutchinson Ravine.

The total background adult and child HIs for the future recreational scenario range from  $4\text{E-}03$  to  $2\text{E-}02$  and from  $9\text{E-}03$  to  $4\text{E-}02$ , respectively. These background HIs equate to approximately 5 to 8 percent of the potential noncarcinogenic risk estimate for the future adult and child recreational user, respectively, at Hutchinson Ravine. The total background potential carcinogenic risk levels for the future recreational user range from  $1\text{E-}06$  to  $7\text{E-}06$ . These background cancer risk estimates equate to approximately 20 percent of the potential carcinogenic risk estimate for the future recreational scenario at Hutchinson Ravine.

#### **Potential Background Risks Associated with the Beach Area**

The total potential background noncarcinogenic and carcinogenic risks associated with exposure to future recreational users at the Beach Area are summarized in Table 5-6. The total background adult and child HIs for the future recreational scenario range from  $2\text{E-}03$  to  $1\text{E-}02$  and from  $1\text{E-}02$  to  $6\text{E-}02$ , respectively. These background HIs equate to approximately 40 percent of the potential noncarcinogenic risk estimate for the adult and child recreational user at the Beach Area. The total background potential carcinogenic risk levels for the future recreational user range from  $3\text{E-}07$  to  $1\text{E-}06$  and equate to approximately 25 percent of the potential carcinogenic risk estimate for the future recreational scenario at the Beach Area.

## 5.5 Uncertainty Analysis

The goal of an uncertainty analysis in a risk assessment is to provide the appropriate decision makers (i.e., risk managers) a wide range of information about risk assessment assumptions, their inherent uncertainty and variability, and the effect of uncertainty and variability on the estimate of potential risk. This subsection discusses the uncertainties in the BRA for the ravines and Beach Area study areas. The major impact of the uncertainty analysis is that the predicted potential risks are relative in nature and do not represent an absolute quantification. This is an important point that is vital to the proper interpretation and understanding of the potential risks presented in this report.

For any potential risk to exist, both exposure to the COPCs and toxicity at the predicted exposure levels must be present. The human health toxicological uncertainties primarily relate to the methodology by which both carcinogenic and noncarcinogenic criteria are developed. As discussed in Section 4.0, the no-threshold theory of cancer development assumes that there is no "risk-free" level of exposure to any constituent that has been shown or suspected to cause cancer. The assumption is that, even if relatively large doses of a constituent were required to cause cancer in laboratory animals, the data can be extrapolated down many orders of magnitude to estimate slope factors for humans. The logic behind this assumption is that, since it is not known if a threshold exists (an uncertainty), the proper approach is to assume a worst-case theory of cancer formation so that it is very unlikely that the risk can be underestimated. With the noncarcinogenic criteria, a variety of uncertainty factors are typically applied to existing data to determine levels at which no effects are expected.

Toxicity criteria for the dermal exposure pathway for some COPCs were derived using default GAFs for VOCs, SVOCs, and inorganics that have been recommended by USEPA (1996c). The GAF values were applied to oral CSFs and oral RfDs. Gastrointestinal absorption of orally administered doses is highly constituent-specific and is dependent upon a number of factors related to the physiological condition of the individual exposed. These default GAFs are crude estimates of the actual gastrointestinal absorption that may occur for any particular constituent and are consequently a source of uncertainty in this risk assessment. Many of the COPCs for the ravines and Beach Area have a higher gastrointestinal absorption than suggested by the default GAFs. Consequently, the risks associated with the dermal exposure pathway may have been overestimated.

In addition, the evaluation of risk associated with dermal exposure to PAHs followed the procedure recommended by USEPA's Exposure Methods Branch and IEPA. In this method, it is assumed that dermal contact with PAHs in soil may cause comparable risks to direct ingestion of the soil. Thus, the oral exposure formula was used to estimate the risk from dermal contact with PAHs in soil. This approach accounts for systemic risks from dermal absorption, but does not account for direct, point of contact effects.

ATSDR (1995a) has reported that no toxicological studies have been conducted that demonstrate a direct association between human dermal exposure to individual PAHs and induction of skin cancer. However, reports of skin tumors among individuals exposed to mixtures containing PAHs lend some qualitative support to their potential for carcinogenicity in humans. In addition, studies in laboratory animals have demonstrated the ability of carcinogenic PAHs to induce skin tumors following intermediate dermal exposure. The risk of skin cancer associated with dermal exposure to PAHs could not be quantified in this risk assessment because there is no appropriate method to characterize these potential point of contact effects. Since the carcinogenic potency associated with these point of contact effects has not been determined, it is difficult to evaluate the potential implications on the calculated risk estimates. Nevertheless, there is some potential that the estimated cancer risks associated with the dermal exposure pathway may have been either unaffected or may have been underestimated.

Inhalation unit risk factors for arsenic and beryllium were converted to internal doses in HEAST. Since these inorganics are suspected to cause tumors at the point of first contact, these conversions may lead to additional uncertainty in the risk assessments. It is possible that the inhalation cancer risk associated with these constituents may have been underestimated.

In addition to toxicology criteria, the risk equation also requires an estimation of the dose that a hypothetical individual may receive from COPCs associated with the ravines and Beach Area study areas. As discussed in earlier sections, exposure scenarios were developed to allow calculation of the exposure and, ultimately, the potential risk. These exposure scenarios are based on a number of assumptions that are common or standard in most risk assessments of this type. These assumptions are designed to be conservative and may likely overestimate exposure. The following paragraphs discuss these exposure assumptions in some detail.

A number of assumptions were made in this BRA that are designed to overestimate exposure in areas where the available data make more specific quantification difficult or impossible. It is inherent in these assumptions that the actual case would clearly result in lower exposure relative to the hypothetical. The assumptions are presented in detail in Section 3.0. The exposure estimates include assumptions concerning exposure point concentrations, fate and transport modeling, and pathway specific exposure parameters. Each category of assumption has an effect resulting in either an over- or underestimation of potential risks at the ravines and Beach Area. The effects of each assumption on the estimation of potential risks for the ravines and Beach Area are presented in Table 5-7.

Many of the COPCs selected for the analysis of risk associated with soil, sediment, and surface water at the ravines and Beach Area were also detected at comparable concentrations in background samples. Risks associated with background were estimated only for the same COPCs and exposure pathways selected for the ravines and Beach Area study areas. As discussed in Section 5.4, background risks

account for up to 40 percent of the risk associated with the ravines and Beach Area for some exposure scenarios. A comparison of the range of exposure point concentrations for the inorganic COPCs at the ravines and Beach Area with the background comparison values and the range of background concentrations reported for Illinois Metropolitan Statistical Areas (IEPA, 1994) are presented on Table 5-8. The exposure point concentrations for the ravines and Beach Area study areas are within the range of background concentrations reported for Fort Sheridan and the State of Illinois.

From this comparison, it is apparent that a portion of the estimated risk associated with the ravines and Beach Area may be due to background conditions instead of a release due to mission-related activities. Consequently, there is a moderate potential that risks associated with mission-related activities at the ravines and Beach Area have been over estimated.

Data were not available for exposure to dusts as discussed in Section 3.0. Constituents in air (dust) were not measured. The use of models and other assumptions to calculate constituent concentrations increases data uncertainty. Generally, the model used to estimate dust concentrations is conservative and tends to predict higher concentrations than would likely occur over time. Consequently, the potential risks associated with the dust pathway may have been overestimated by as much as one order of magnitude.

Overall, there is a moderate potential for overestimation of potential human health risks at the ravines and Beach Area study areas. It is especially high for the RME through each pathway evaluated. Exposures through the direct contact pathway assumed that the exposure point concentrations were from the most affected areas at the ravines and Beach Area regardless of accessibility. As a result of these conservative assumptions, the potential risks to most human receptors may have been overestimated by at least one order of magnitude and have a moderate degree of uncertainty associated with the analysis.

The potential risks presented in this section need to be viewed in light of the information presented in Table 5-7. This table illustrates the fact that, although some uncertainty does exist that would indicate a potential for underestimation (i.e., either overestimation or underestimation), there is no significant underestimation identified. Furthermore, there are a significant number of assumptions that represent moderate to high overestimations of potential risks.

Table 5-1. Summary of Potential Human Health Risks Associated with Janes Ravine

Exposure Scenario/Pathway	Group	Hazard Index		Cancer Risk Level*	
		RAE	RME	RAE	RME
Current Recreational (Golfer)					
Surface Water Ingestion	Adult	4E-07	2E-06	--	--
Dermal Absorption - Surface Water	Adult	1E-05	7E-05	--	--
Sediment Ingestion	Adult	1E-04	5E-04	1E-08	5E-08
Dermal Absorption - Sediment	Adult	6E-03	3E-012	4E-07	2E-06
Total	Adult	6E-03	3E-02	4E-07	2E-06
Future Recreational (Hiker)					
Surface Water Ingestion	Adult	2E-06	1E-05	--	--
	Child	1E-05	6E-05	*	*
Dermal Absorption - Surface Water	Adult	8E-05	4E-04	--	--
	Child	2E-04	8E-04	*	*
Sediment Ingestion	Adult	1E-03	5E-03	2E-07	1E-06
	Child	1E-02	5E-02	*	*
Dermal Absorption - Sediment	Adult	1E-02	5E-02	8E-07	4E-06
	Child	2E-02	1E-01	*	*
Total	Adult	1E-02	6E-02	1E-06	6E-06
	Child	4E-02	2E-01	*	*

-- No carcinogenic constituents of potential concern were detected for this pathway.

RAE = reasonable average exposure

RME = reasonable maximum exposure

\* Lifetime cancer risk estimate. Childhood cancer risk is included in value presented for adult.

Source: QST, 1998.

Table 5-2. Summary of Potential Human Health Risks Associated with Hutchinson Ravine

Exposure Scenario/Pathway	Group	Hazard Index		Cancer Risk Level*	
		RAE	RME	RAE	RME
Current Recreational (Golfer)					
Surface Water - Ingestion	Adult	4E-06	2E-05	1E-11	6E-11
Dermal Absorption - Surface Water	Adult	2E-04	1E-03	1E-08	6E-08
Sediment Ingestion	Adult	6E-05	3E-04	1E-07	5E-07
Dermal Absorption - Sediment	Adult	4E-03	2E-02	2E-07	1E-06
Total	Adult	4E-03	2E-02	4E-07	2E-06
Future Recreational (Hiker)					
Surface Water - Ingestion	Adult	2E-05	1E-04	8E-11	4E-10
	Child	1E-04	6E-04	*	*
Dermal Absorption - Surface Water	Adult	1E-03	6E-03	1E-07	5E-07
	Child	2E-03	1E-02	*	*
Sediment Ingestion	Adult	6E-04	3E-03	2E-06	1E-05
	Child	6E-03	3E-02	*	*
Dermal Absorption - Sediment	Adult	6E-03	3E-02	2E-06	1E-05
	Child	1E-02	6E-02	*	*
Total	Adult	8E-03	4E-02	5E-06	3E-05
	Child	2E-02	1E-01	*	*

RAE = reasonable average exposure

RME = reasonable maximum exposure

\* Lifetime cancer risk estimate. Childhood cancer risk is included in value presented for adult.

Source: QST, 1998.



Table 5-3. Summary of Potential Human Health Risks Associated with the Beach Area

Exposure Scenario/Pathway	Group	Hazard Index		Cancer Risk Level*	
		RAE	RME	RAE	RME
Future Recreational (Hiker)					
Surface Water Ingestion	Adult	4E-05	2E-04	1E-11	5E-11
	Child	8E-04	4E-03	*	*
Dermal Absorption - Surface Water	Adult	2E-04	1E-03	8E-11	4E-10
	Child	2E-03	1E-02	*	*
Sediment Ingestion	Adult	2E-03	9E-03	8E-07	4E-06
	Child	2E-02	8E-02	*	*
Dermal Absorption - Sediment	Adult	4E-03	2E-02	2E-07	1E-06
	Child	8E-03	4E-02	*	*
Total	Adult	6E-03	3E-02	1E-06	5E-06
	Child	3E-02	1E-01	*	*

RAE = reasonable average exposure

RME = reasonable maximum exposure

\* Lifetime cancer risk estimate. Childhood cancer risk is included in value presented for adult.

Source: QST, 1998.

Table 5-4. Summary of Potential Background Human Health Risks Associated with Janes Ravine

Exposure Scenario/Pathway	Group	Hazard Index		Cancer Risk Level*	
		RAE	RME	RAE	RME
Current Recreational (Golfer)					
Surface Water - Ingestion	Adult	4E-07	2E-06	--	--
Dermal Absorption - Surface Water	Adult	1E-05	6E-05	--	--
Sediment - Ingestion	Adult	2E-06	1E-05	1E-08	7E-08
Dermal Absorption - Sediment	Adult	1E-04	5E-04	2E-08	1E-07
Total	Adult	1E-04	6E-04	3E-08	2E-07
Future Recreational (Hiker)					
Surface Water - Ingestion	Adult	2E-06	1E-05	--	--
	Child	1E-05	5E-05	*	*
Dermal Absorption - Surface Water	Adult	8E-05	4E-04	--	--
	Child	1E-04	7E-04	*	*
Sediment - Ingestion	Adult	2E-05	1E-04	1E-07	2E-06
	Child	2E-04	1E-03	*	*
Dermal Absorption - Sediment	Adult	2E-04	1E-03	4E-07	2E-06
	Child	4E-03	2E-03	*	*
Total	Adult	4E-04	2E-03	8E-07	4E-06
	Child	8E-04	4E-03	*	*

-- No carcinogenic constituents of potential concern were detected for this pathway.

RAE = reasonable average exposure

RME = reasonable maximum exposure

\* Lifetime cancer risk estimate. Childhood cancer risk is included in value presented for adult.

Source: QST, 1998.

Table 5-5. Summary of Potential Background Human Health Risks Associated with Hutchinson Ravine

Exposure Scenario/Pathway	Group	Hazard Index		Cancer Risk Level*	
		RAE	RME	RAE	RME
Current Recreational (Golfer)					
Surface Water - Ingestion	Adult	6E-07	3E-06	1E-11	7E-11
Dermal Absorption - Surface Water	Adult	8E-04	4E-03	8E-08	4E-07
Sediment - Ingestion	Adult	2E-06	1E-05	1E-08	7E-08
Dermal Absorption - Sediment	Adult	8E-05	4E-04	2E-08	9E-08
Total	Adult	8E-04	4E-03	1E-07	5E-07
Future Recreational (Hiker)					
Surface Water - Ingestion	Adult	4E-06	2E-05	1E-10	5E-10
	Child	1E-05	7E-05	*	*
Dermal Absorption - Surface Water	Adult	4E-03	2E-02	6E-07	3E-06
	Child	8E-03	4E-02	*	*
Sediment - Ingestion	Adult	2E-05	1E-04	4E-07	2E-06
	Child	2E-04	1E-03	*	*
Dermal Absorption - Sediment	Adult	2E-04	8E-04	4E-07	2E-06
	Child	4E-04	2E-03	*	*
Total	Adult	4E-03	2E-02	1E-06	7E-06
	Child	9E-03	4E-02	*	*

RAE = reasonable average exposure

RME = reasonable maximum exposure

\* Lifetime cancer risk estimate. Childhood cancer risk is included in value presented for adult.

Source: QST, 1998.

Table 5-6. Summary of Potential Background Human Health Risks Associated with the Beach Area

Exposure Pathway		Hazard Index		Cancer Risk Level*	
		RAE	RME	RAE	RME
Future Recreational (Hiker)					
Surface Water - Ingestion	Adult	4E-06	2E-05	--	--
	Child	8E-05	4E-04	*	*
Dermal Absorption - Surface Water	Adult	1E-04	7E-04	--	--
	Child	1E-03	5E-03	*	*
Sediment - Ingestion	Adult	6E-04	3E-03	2E-07	1E-06
	Child	6E-03	3E-02	*	*
Dermal Absorption - Sediment	Adult	2E-03	1E-02	6E-08	3E-07
	Child	4E-03	2E-02	*	*
Total	Adult	2E-03	1E-02	3E-07	1E-06
	Child	1E-02	6E-02	*	*

-- No carcinogenic constituents of potential concern were detected for this pathway.

RAE = reasonable average exposure

RME = reasonable maximum exposure

\* Lifetime cancer risk estimate. Childhood cancer risks are included in values presented for the adult.

Source: QST, 1998.

Table 5-7 Summary of Uncertainty Analysis for the Ravines and Beach Area Study Areas

Source of Uncertainty	Potential for Over Estimation	Potential for Under Estimation	Potential for Over or Under Estimation
<b>Environmental Data</b>			
Adequacy of Environmental Database			Low
<b>Constituent Selection</b>			
Background	Moderate		
<b>Fate and Transport Models</b>			
Dust Model	High		
<b>Exposure Parameter Estimation</b>			
Standard assumptions regarding body weight, period exposed, life expectancy, population characteristics, and lifestyle			Moderate
Media Intake Rates	Moderate		
Exposure Frequency	Moderate		
Exposure Duration	Moderate		
Dermal Absorption Factors	Moderate		
Future Exposure Point Concentrations	Moderate		
<b>Toxicity Data</b>			
USEPA RfDs and CSFs	Moderate		

CSF = cancer slope factor

RfD = reference dose

Source: QST, 1998.

Table 5-8. Comparison of Exposure Concentrations for Inorganic COPCs to Background Levels

Constituent	Medium	Exposure Point Concentration	Units	Fort Sheridan Background	Illinois Background
<b>Janes Ravine</b>					
Manganese	SW	0.165	mg/L	0.15*	NA
<b>Hutchinson Ravine</b>					
Manganese	SW	0.891	mg/L	0.15*	NA
Sulfate	SW	155	mg/L	ND	NA
<b>Beach Area</b>					
Arsenic	SD	6.85	mg/kg	2.26†	4.1 - <14**
Beryllium	SD	0.251	mg/kg	ND	NA
Manganese	SD	468	mg/kg	226†	500 - <1,700**
Manganese	SW	0.276	mg/L	0.15*	NA
Sulfate	SW	247	mg/L	ND	NA

mg/kg = milligrams per kilogram

mg/L = milligrams per liter

NA = not available

ND = no data

SD = sediment

SW = surface water

\* 95% UCL of background data.

† Maximum detected concentration.

\*\* Stream and lake sediment data.

Sources: IEPA, 1994; QST, 1998; and Mitzelfelt, 1996.

## 6.0 Problem Formulation for the Ecological Risk Assessment

The objectives of the ecological risk assessment are to utilize currently available information and data regarding ecological COPCs (ecoCOPCs), ecotoxicology, and ecology to estimate the potential for undesirable ecological effects and to provide a means of balancing and comparing potential risks associated with environmental problems (Wentzel *et al.*, 1996). This baseline ecological risk assessment was performed to evaluate the potential for adverse ecological effects to the environment (ecological resources) at the Janes Ravine, Hutchinson Ravine, and Beach Area (as well as the immediately adjacent littoral zone of Lake Michigan) study areas due to the constituents present in sediments and surface water at these areas at Fort Sheridan. Results of the ecological risk assessment were used to:

- Determine if specific ecoCOPCs associated with the ravines and Beach Area are significantly adversely affecting ecological receptors;
- Determine if the potential risks from specific constituents are greater than the acceptable range; and
- Assist in the determination of whether remedial actions are necessary.

These results may also be used to help select remedial alternatives that are not themselves environmentally destructive and to prioritize areas needing remedial actions. Based upon the ecological risk assessment results, remediation objectives may also be derived.

This ecological risk assessment follows the currently accepted process that consists of the following components:

- Problem formulation (Section 6.0);
- Analysis (Section 7.0) which includes characterization of both exposure and ecological effects; and
- Potential risk characterization (Section 8.0).

This ecological risk assessment is conducted in accordance with the Tri-Service Procedural Guidelines for Ecological Risk Assessment (U.S. Army Edgewood Research, Development and Engineering Center (ERDEC) (Wentzel *et al.*, 1996). It is also consistent with:

- Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual, EPA/540/1-89/001 (USEPA, 1989b);
- USEPA Region V, Regional Guidance for Conducting Ecological Assessments (no date);
- Terrestrial Ecological Risk Assessment, Army Materials Technology Laboratory, SSIM-AEC-BC-CR-95071 (USEPA, 1995c);
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, USEPA, Environmental Response Team, June 5, 1997 (Interim Final); and

- Proposed Guidelines for Ecological Risk Assessment, USEPA Risk Assessment Forum, EPA/630/R-95/002B, 1996 (Draft).

## 6.1 Stressor Characteristics

Data are available for groundwater, sediments and surface water associated with Janes Ravine, Hutchinson Ravine, and the Beach Area and sediments in the littoral zone of Lake Michigan. A detailed discussion of analytical data is presented in Section 2.0. Results of sampling efforts conducted between 1991 and 1996 indicate that metals, PAHs, and explosives-related compounds are present in Beach Area groundwater samples and in surface water and sediment samples collected at Janes and Hutchinson Ravines and the Beach Area (see Volume I).

## 6.2 Identification of Ecosystem(s) Potentially at Risk

Most of the natural habitat at Fort Sheridan has been disturbed as a result of extensive residential, commercial, and industrial development. As a result, the presence of well-defined, distinct natural communities is limited. Approximately 600 acres of Fort Sheridan consist of artificially maintained, landscaped habitat including manicured lawns and horticultural vegetation (USACE, 1990). Approximately 100 acres are undeveloped and contain a variety of native tree, shrub, and herbaceous species, as well as several mosses and liverworts. As a result of extensive development at Fort Sheridan, few undisturbed, distinct natural communities exist, and species diversity and densities have been reduced. The ravines, Lake Michigan shoreline and bluffs, golf course, and undeveloped areas of Fort Sheridan and the adjacent wildlife preserve provide the most habitat for wildlife species found onsite (USACE, 1990).

The undeveloped areas of Fort Sheridan are characterized by ravines, bluffs, and the shoreline of Lake Michigan, which forms the eastern boundary of the installation (USACE, 1990). Six ravines drain the area of the installation, but the natural vegetation and community structure of these ravines have been seriously disturbed. Some have been used as landfills and storm sewer drainages, and one (Bartlett Ravine) has been paved for use as a roadway to the beach (Gross *et al.*, 1982). In the past, activities at the Beach Area bluff included disposal of ordnance and use as a small arms firing range. Storm water drainage at the installation primarily follows the ravine system including Janes and Hutchinson Ravines which discharge into Lake Michigan via the shoreline/beach area. Habitat within each of these ravines is somewhat limited due to scattered vegetation and erosion with subsequent sedimentation of drainage channels.



### **Preliminary Exposure Pathways**

The stressors identified in Section 6.1 may cause adverse effects to ecological receptors. However, for adverse effects to be caused, the receptors in the ecosystems [Janes Ravine, Hutchinson Ravine, and the Beach Area (including the littoral zone)] must be exposed to these stressors for enough time and in sufficient concentrations to produce the adverse effect. Suitable habitat within each of the study areas is limited by development or other anthropogenic causes that have occurred in the past at Fort Sheridan. It is important to consider the fact that, although the exposure at these areas is relatively limited, the potential exists for wildlife species of interest to come in contact with constituents in surface water and/or sediments. Surface water and sediments have been found to contain mission-related constituents. Generalized potential exposure pathways by which terrestrial and aquatic organisms may come into contact with constituents at Janes Ravine, Hutchinson Ravine, and Beach the Area (including the littoral zone) include:

- Ingestion of or dermal contact with sediments by benthic invertebrates or wildlife;
- Ingestion of or dermal contact with surface water by benthic invertebrates or wildlife; and
- Ingestion of prey.

Sediments and surface water are evaluated for the ravines and Beach Area (sediments only in the littoral zone) as these media represent the most significant pathways for ecological exposure to constituents. Because some of the stressor constituents do bioaccumulate, the extent to which the ingestion of prey may be a significant pathway will be evaluated after selection of constituents of potential concern to ecological receptors (ecoCOPCs) and evaluation of primary (direct) exposure to surface water and sediments.

## **6.3 Ecological Effects**

Fort Sheridan resources include natural and disturbed habitats including forested ravine systems with an aquatic element, bluff communities, grasslands, and lake shore systems associated with Lake Michigan. Recent surveys for fauna at Fort Sheridan confirm a nearly complete lack of fish, amphibians, and reptiles in ravines despite the presence of suitable habitat and the identification of several species in previous studies (U.S. Navy, 1995). It is probable that fish cannot maintain populations in the ravine areas due to the dynamic conditions present. Lack of flowing water during drought and low flow conditions, which are natural for these habitats, would contribute to the lack of fish populations. The lack of fish, however, should allow for increased amphibian populations. The ravine banks appear to offer excellent habitat for adult amphibians. Plentiful surface water in the ravine pools during snowmelt provides ideal habitat for amphibian reproduction. The near absence of amphibians may, therefore, be due to constituent stressors rather than ecosystem structure or other natural explanations. Physical conditions of the ravine banks may contribute to the lack of a well developed aquatic system. Significant erosion of ravine slopes has been noted to cause high sediment loads in the aquatic portion of the system

and is likely to produce a negative effect on maintaining a healthy aquatic ecosystem. Data concerning species presence and abundance are not available for offsite ravines which would enable a site-specific comparison. Also, site-specific data regarding benthic invertebrates were not available during problem formulation. If benthic communities are lacking in diversity or richness, it follows that higher forms of aquatic life will also be minimized.

General surveys of wildlife species indicate that numerous avian and mammalian species may be found in and around the ravines of the installation (U.S. Navy, 1995). Although these surveys indicate the potential for exposure, they were not designed to identify population effects. Examples of wildlife of interest include, but are not limited to, amphibians, woodchucks, and raccoons. Feral cats are also plentiful at Fort Sheridan and are also evaluated as they are representative of potentially occurring non-feral animals (pets) due to conversion of much of the surplus property to residential use.

Abiotic media that contain potential constituent stressors and are encountered by ecological receptors include surface water and sediments. Screening level ecological effects benchmarks (or criteria) were identified (if available) from the literature for constituents identified in groundwater, surface water, and sediment. These conservative screening values were used to help develop the ecoCOPCs in Section 7.2. Potential ecological effects, including site-specific test results and review of the ecotoxicity of ecoCOPCs, are characterized further in Section 8.2.

## 6.4 Endpoint Selection

Based upon the review of potential constituent stressors, potential exposure pathways in the ravines and Beach Area ecosystems and potential ecological effects, ecologically-based endpoints have been chosen for further evaluation. These endpoints were formulated with the collaborative effort of risk assessors and risk managers as a scientific/management decision point.

### 6.4.1 Assessment Endpoints

The primary issues to be addressed in the ecological risk assessment are stated as assessment endpoints. An assessment endpoint is defined as an explicit description of the ecological value to be protected (Wentzel *et al.*, 1996). Assessment endpoints generally have both a biological and societal value, so that scientific information and risk management goals can be linked. Assessment endpoints selected for this evaluation include:

- Assessment Endpoint 1--adverse population effects on terrestrial wildlife (i.e., woodchucks, raccoons, shrews, and feral cats) due to ingestion of ecoCOPCs from surface water via drinking.
- Assessment Endpoint 2--adverse population effects on amphibians due to direct exposure of egg masses and larval amphibians to ecoCOPCs in surface water.

- Assessment Endpoint 3--adverse population response by aquatic invertebrates and fish to direct exposure to ecoCOPCs in surface water in the ravines and Lake Michigan, respectively
- Assessment Endpoint 4--adverse population or community effects on benthic invertebrates due to exposure to ecoCOPCs in sediments.
- Assessment Endpoint 5--adverse population effects on raccoons due to incidental ingestion of ecoCOPCs in sediments.
- Assessment Endpoint 6--adverse population effects on avian species (common snipe) due to incidental ingestion of ecoCOPCs in sediments.
- Assessment Endpoint 7--adverse population effects on terrestrial and aquatic species due to bioaccumulation of ecoCOPCs in the food chain.

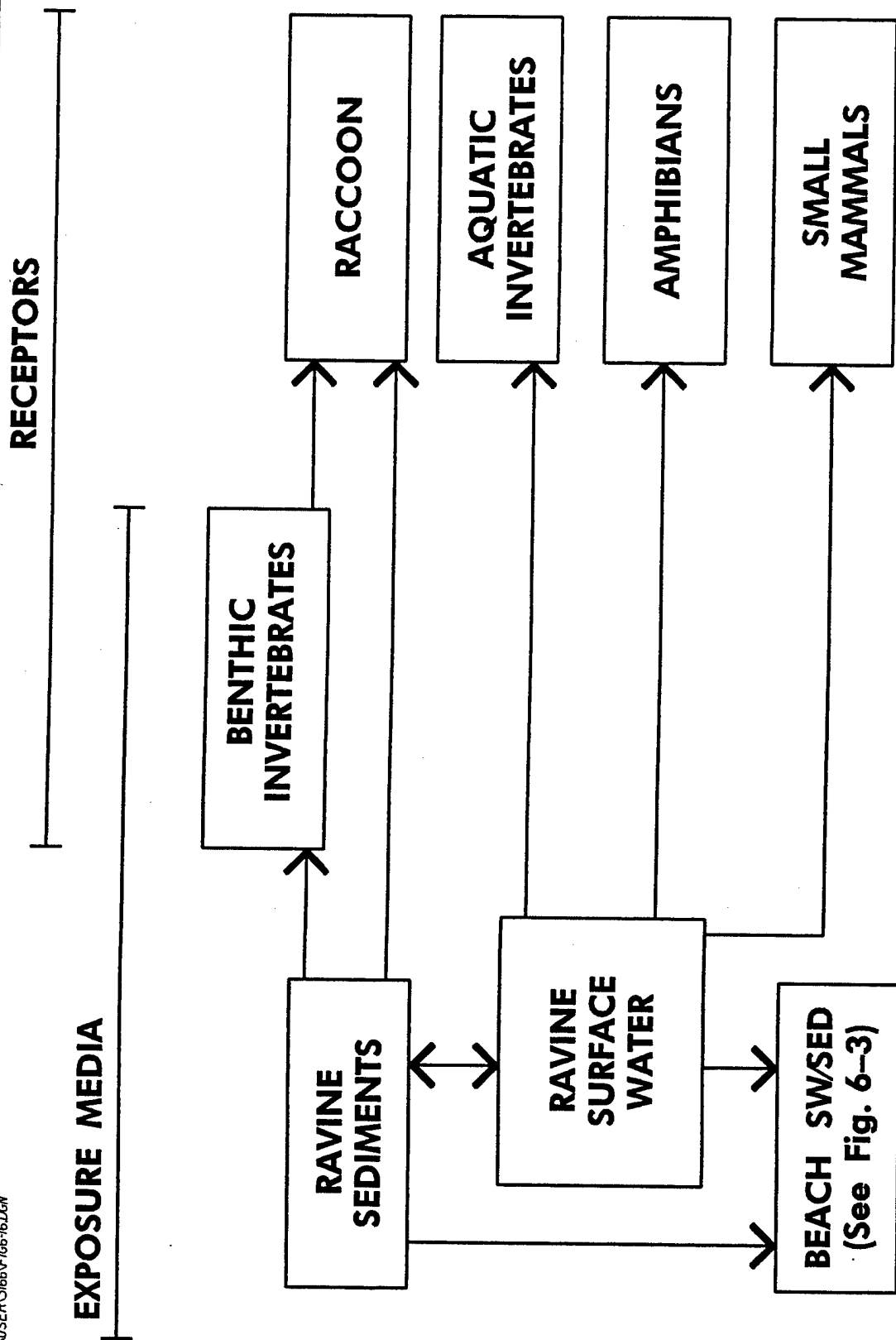
#### 6.4.2 Measurement Endpoints

Adverse population effects can be expected if mortality, reproductive impairment, or significant growth reductions occur. Indirect effects may also occur, but are not as readily evaluated with the data available. Changes in populations may also cause significant changes in community and ecosystem structure. Fundamental changes in populations are ecologically relevant, and can generally be inferred from acute or chronic ecotoxicity benchmarks related to mortality, reproductive impairment, and (in some cases) growth reduction. Measurement endpoints that correspond to the assessment endpoints include the following:

- Measurement Endpoint 1--drinking water benchmarks for ecoCOPCs associated with NOAELS or lowest observed adverse effect levels (LOAELs) for mortality or reproductive effects (if available).
- Measurement Endpoint 2--aquatic ecotoxicity benchmark values for ecoCOPCs (laboratory or field studies) for impairment of amphibian reproductive success.
- Measurement Endpoint 3--results of site-specific fathead minnow bioassays using groundwater samples and aquatic invertebrate ecotoxicity benchmark values for ecoCOPCs.
- Measurement Endpoint 4--results of site-specific sediment chronic bioassays using sediments from Janes and Hutchinson Ravines and the Beach Area and sediment ecotoxicity benchmark values for ecoCOPCs in Lake Michigan sediment.
- Measurement Endpoint 5--dietary benchmarks for mammals associated with NOAELs or LOAELs (if available) and adjusted for incidental sediment ingestion of ecoCOPCs.
- Measurement Endpoint 6--dietary benchmarks for avian species associated with NOAELs or LOAELs (if available) and adjusted for incidental sediment ingestion of ecoCOPCs.
- Measurement Endpoint 7--dietary benchmarks associated with NOAELs or LOAELs (if available) and adjusted or ingestion of ecoCOPCs bioaccumulated in prey by avian species or terrestrial mammals, and direct measurement of body burdens in *L. variegatus*.

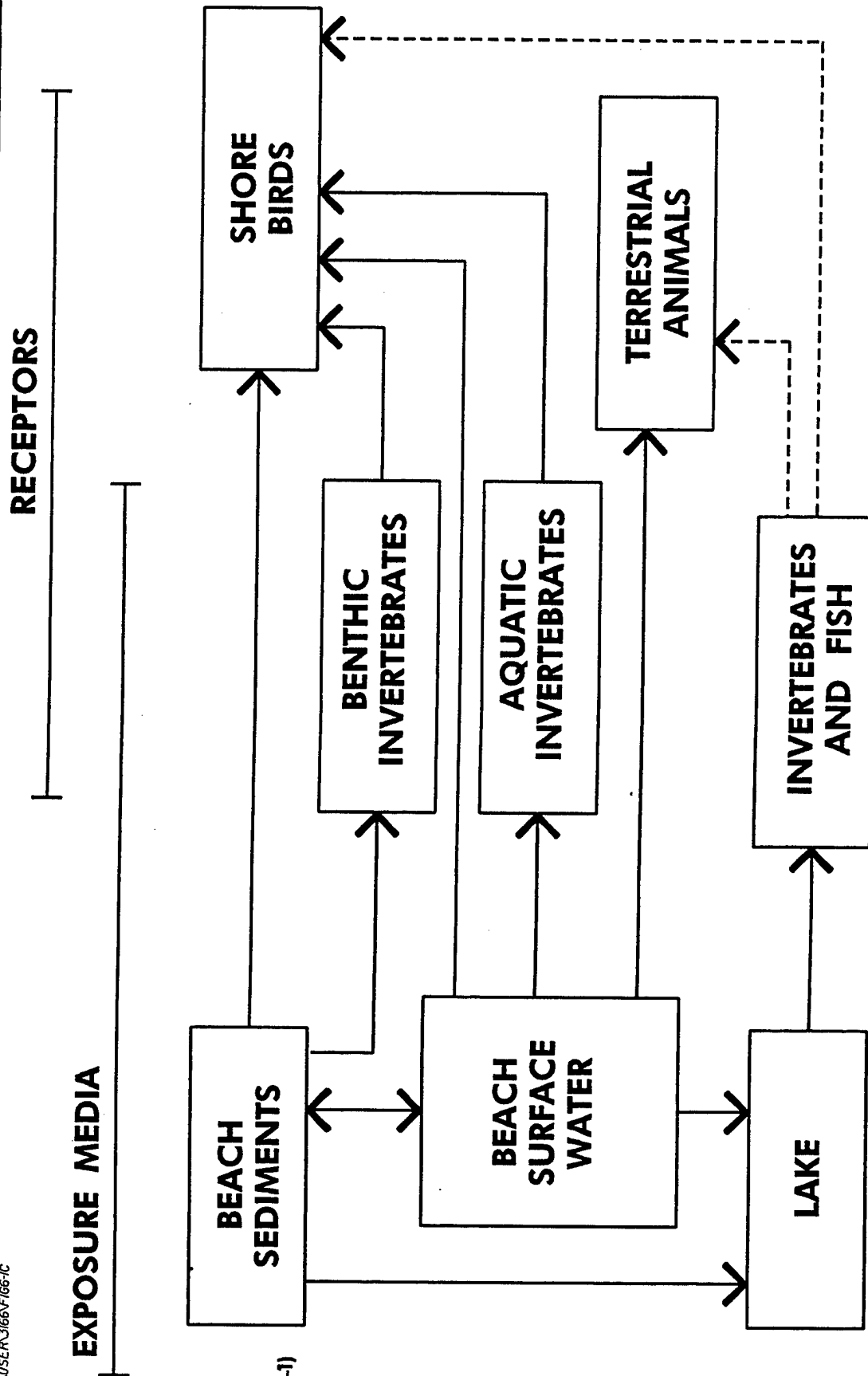
## **6.5 Conceptual Model**

The conceptual model based upon the ecosystem(s) potentially at risk, the selected endpoints, and the potential exposure to constituent stressors from Janes Ravine, Hutchinson Ravine, and the Beach Area are presented in Figures 6-1 and 6-2.



**Figure 6-1**  
**CONCEPTUAL MODEL FOR JAMES AND HUTCHINSON RAVINES**  
**IN THE SURPLUS OU FOR THE ECOLOGICAL RISK ASSESSMENT**  
**FT. SHERIDAN, ILLINOIS**





(See Fig 6-1)

**Figure 6-2**  
**CONCEPTUAL MODEL FOR THE BEACH AND LAKE AREAS OF THE**  
**SURPLUS OU IN THE ECOLOGICAL RISK ASSESSMENT**  
**FT. SHERIDAN, ILLINOIS**

## 7.0 Exposure and Ecological Effects Analyses

With the problem formulation phase completed, the ecological risk assessment process proceeds to the analysis phase. During the analysis phase, the exposure and ecological effects analyses are completed and linked together. A detailed description of data evaluation and data collection procedures, including the background ANOVA evaluation for ecoCOPCs, are presented in Section 2.0.

### 7.1 Characterization of Exposure

The characterization of exposure is a key element of any ecological risk assessment. Although constituent stressors may be present, if receptors are not exposed to these constituents, no adverse effects would be anticipated. Exposure is characterized by three steps:

- Evaluating the constituent stressors, selecting ecoCOPCs, and evaluating the fate of ecoCOPCs in the environment;
- Characterizing the ecosystem that may be exposed; and
- Developing the specific exposure pathways to be evaluated as identified in the conceptual model.

#### 7.1.1 Stressor Characterization

The stressor characterization for Janes Ravine, Hutchinson Ravine, and the Beach Area (including the Lake Michigan littoral zone) focuses on the constituents present at these study areas. It is understood that other ecological stressors, both natural and anthropogenic, may also be influencing the ecosystems of interest. Examples of such stressors include, but are not limited to:

- Janes and Hutchinson Ravines
  - Erosion of ravine banks, both natural and due to human activities;
  - Runoff from roadways, and
  - Dumping of yard wastes and other refuse.
- Beach Area
  - Erosion of shoreline and bluff areas, due to both natural and human activities;
  - Runoff from roadways;
  - Discharge of stormwater runoff; and
  - Routine landscaping maintenance (mowing, pruning).
- Lake Michigan
  - Erosion of shoreline and bluffs resulting in sedimentation;
  - Industrial and municipal waste discharge; and
  - Commercial and recreational boat traffic.

Groundwater associated with the Surplus OU is assessed in the ecological risk assessment as part of the Beach Area because it represents a direct transport pathway to Lake Michigan (see Section 2.0). Additionally, Beach Area sediments and surface water and Lake Michigan sediments are also evaluated for exposure potential. Potential exposures to ravine sediments and surface water are assessed for Janes and Hutchinson Ravines. Finally, the extent to which some of these media (ravine and Beach Area sediments) contribute to the food web pathway is also evaluated. The data used for the following analysis were defined in Section 2.0 and the data summaries are provided in Appendix B.

#### 7.1.1.1 Data Evaluation for Selection of Ecological COPCs

Upon completion of the appropriate data set evaluations (see Section 2.0), specific preliminary ecoCOPCs are selected for each of the study areas (Janes and Hutchinson Ravines, Beach Area, and Lake Michigan). EcoCOPCs are site-related constituents that may pose the most risks to eco-receptors due to toxicity, bioaccumulation, etc. The ecoCOPC selection was conducted according to procedures and guidelines presented in various USEPA agency-wide and region-specific guidance, if available. Preliminary review of the data sets showed that metals, PAHs, munitions, and pesticides are likely to dominate the ecoCOPC list. The steps used to select ecoCOPCs by reduction of the initial list of potential ecoCOPCs include:

- Comparison of the detected inorganic concentrations to background concentrations by study area and medium (see Section 2.0);
- Comparison of the maximum concentration of a constituent in surface water or sediment to a conservative ecotoxicity screening value. Screening criteria are selected from region-specific guidance, national standards, criteria and screening values (e.g. USEPA), or other relevant sources [toxicological studies reviewed from the literature, or compilations of these, and for this site, Ontario Ministry of the Environment (OME) sediment values]. Region V guidance is very limited for ecological screening criteria for specific constituents. Therefore, screening values were acquired from other regions (i.e., USEPA Regions III and IV). Screening values must be relevant for the medium evaluated and the endpoint of interest. Special attention must also be given to site-specific chemical conditions for each constituent, such as TOC for organic constituents and hardness for inorganics. Specific parameters may be adjusted for site-specific conditions, which will result in altered toxicity values. Professional judgement is exercised to select the most relevant and applicable benchmarks to ensure relevance to the study areas and receptors of interest, conservatism, and benchmarks relative to the measure and assessment endpoints of interest.
- Consideration of the constituent itself in terms of natural occurrence, similarity to other constituents, and essential nutrients. Some professional judgement is used in this evaluation step when considering the potential for natural occurrence of a constituent. One must determine whether regional and site-specific data are conclusive enough to eliminate constituents from the ecoCOPC list. Also, judgement is necessary to determine if groups or families of constituents are



sufficiently represented as ecoCOPCs. For example, subsequent to the data evaluation, 15 PAHs are included in the ecological risk assessment data set. Best professional judgment should be used to determine which PAHs have the potential for significant effects on ecological receptors and, therefore, should be carried through the remainder of the evaluation. Essential nutrients are not retained as potential ecoCOPCs based upon the dietary needs of these constituents by ecological receptors. Essential nutrients include, but are not limited to calcium, potassium, magnesium, nitrogen, phosphate, iron, and sodium.

- EcoCOPCs that have been removed from consideration by the previous steps may be retained as potential ecoCOPCs due to potential for bioaccumulation and exceedance of site-specific ARARs. Constituents that have been removed as potential ecoCOPCs by the previous steps may be retained if they exhibit a strong potential to bioaccumulate in the environment. Typically, bioconcentration factors (BCFs) of 100 are used as a starting point to determine if constituents bioaccumulate. If the BCF for a constituent exceeds 100, typically a comparison is made between the screening criteria and the constituent concentration. A judgement is then made as to whether to retain the constituent or eliminate it. Additionally, if similar members of a group of constituents are represented (PAHs), the constituent may be eliminated. Constituents may also be retained as ecoCOPCs if site-specific concentrations exceed local and/or state guidance. For Fort Sheridan, IAC criteria are used as additional screening criteria for surface and groundwater constituents. If a constituent is screened out using regional criteria, yet fails the IAC screening step, it is retained as a potential ecoCOPC.
- Evaluation of the frequency of detection of a constituent and its relationship to known site-related constituents may be used to eliminate potential ecoCOPCs from further consideration. Constituents not known to be related to mission activities that are detected in less than 5 percent of the analytical samples may be removed from the list of ecoCOPCs.

EcoCOPCs are selected to limit the number of constituents to be evaluated to those that represent the greatest portion of the potential risk. Screening values are low to help ensure that no constituent is eliminated from considerations without warrant. Surface water data used in the ecological risk assessment were for unfiltered samples. The use of unfiltered samples is a conservative approach to estimate ecological risks because, although a constituent may be measured in the unfiltered sample, it may be associated with particulates and, therefore, not readily bioavailable. Some constituents also have screening level values and criteria [e.g., Ambient Water Quality Criteria (AWQCs)] that vary with general water chemistry such as hardness. Water hardness for surface water and groundwater within the study areas has a range of 545 mg/L (Janes Ravine surface water) to 682 mg/L (groundwater) of calcium carbonate ( $\text{CaCO}_3$ ) (see Appendix I). Surface water screening values used in this assessment (Tables 7-1 and 7-2) have been adjusted using a site-specific average water hardness of 651 mg/L of  $\text{CaCO}_3$  (Tables 7-3 and 7-4).

The sediment screening values (Table 7-5) include values that are calculated for a sediment total organic carbon (TOC) content of 1 percent. The bioavailability of many constituents is inversely related to the TOC content. The TOC for sediment samples collected in Janes and Hutchinson Ravines and the ravine discharge areas along the beach exceed 1 percent. Therefore, those screening values are especially conservative in that they overestimate the bioavailability of these constituents in Fort Sheridan sediments.

The results of the ecotoxicity screening for the various media are presented by study area in Tables 7-6 through 7-13. The sediment screening results for Janes Ravine, Hutchinson Ravine, and the Beach Area (including Lake Michigan) are presented in Tables 7-6 through 7-9, respectively. Surface water screening results are presented in Tables 7-10 through 7-12 for Janes Ravine, Hutchinson Ravine, and the Beach Area, respectively. Groundwater screening results for the Beach Area are presented in Table 7-13.

Constituents that exceeded the ecotoxicity screening values were evaluated individually to determine if the constituent was naturally occurring, site-related, or an essential nutrient. Essential nutrients eliminated as potential ecoCOPCs for the Beach Area media include calcium, chloride, magnesium, iron, potassium, nitrogen, and sodium. Essential nutrients eliminated as potential ecoCOPCs for Janes Ravine media include calcium, chloride, and nitrogen, and for Hutchinson Ravine media include calcium, chloride, nitrogen, and sodium.

Constituents eliminated as potential ecoCOPCs by the previous steps were considered for retention based upon the potential for bioaccumulation and exceedance of site-specific ARARs, namely IAC criteria for surface water and groundwater. Preliminary ecoCOPCs eliminated during the screening process include metals, PAHs, and pesticides. Based strictly upon the potential to bioaccumulate, two constituents were retained as potential ecoCOPCs: DDT in Janes Ravine surface water and zinc in groundwater. Additionally, cadmium and zinc were retained as potential ecoCOPCs for Hutchinson Ravine and Beach Area sediments, respectively, based upon their potential to bioaccumulate in the environment and because they were detected in worm tissue (*L. variegatus*) samples. The screening process also incorporated IAC surface water criteria in determining final ecoCOPCs for surface water and groundwater. This screening is presented in Table 7-14. Consideration was given to retain iron, detected in ravine surface water, as a potential ecoCOPC based upon exceedance of IAC screening criteria. However, because iron concentrations in ravine surface water were below site-specific background concentrations and iron is considered to be an essential nutrient, it was not retained as a potential ecoCOPC. Therefore, no constituents were retained based solely upon IAC criteria exceedances.

As a final step in determining ecoCOPCs, constituents were evaluated for removal from the preliminary list of ecoCOPCs based on site-specific circumstances, such as low frequency of detection. Constituents that are infrequently detected may be anomalies in the data due to sampling errors or analytical errors

and, therefore, may not be site-related. Potential ecoCOPCs eliminated in this step include acetone and beryllium for groundwater. A complete discussion on the frequency of detection screening procedure is presented in Section 2.0 with the accompanying data summaries presented in Appendix B2.

Based on the selection methodology presented in this section and Section 2.0, the ecoCOPCs chosen for Janes Ravine, Hutchinson Ravine, and the Beach Area (including Lake Michigan) include explosives, PAHs, metals, and pesticides. These ecoCOPCs are presented in Tables 7-15 through 7-17, respectively.

#### **7.1.1.2 Summary of Uncertainties Associated with Identification of EcoCOPCs**

Numerous uncertainties exist in the determination of ecoCOPCs for sediment, surface water, and groundwater media at the ravines and Beach Area study areas. Most of the uncertainties associated with the identification of ecoCOPCs are presented in Section 2.0. The potential exists that some constituents may be present in environmental media at concentrations below MDLs. There is also the potential that the samples collected may not accurately represent the constituent concentrations present in the ravines and Beach Area. The ecotoxicity benchmark screening removes constituents from further consideration as ecoCOPCs based solely on toxicity. Available toxicity data are limited and may not be applicable to the specific species present at Fort Sheridan.

#### **7.1.1.3 Physical and Chemical Parameters of EcoCOPCs**

The physical and chemical attributes of the ecoCOPCs help define the fate and transport of these constituents and the degree to which these constituents may contact receptors, be bioavailable, and bioaccumulate. Relevant physical/constituent parameters for organic and inorganic ecoCOPCs are presented in Tables 7-18 and 7-19, respectively.

### **7.1.2 Ecosystem Characterization**

The ecosystems of interest consist of the ravine areas at both Janes and Hutchinson Ravines, the shoreline and intermediate zone at the Beach Area, and the littoral zone of Lake Michigan. The abiotic and biotic attributes are described in the following sections.

### 7.1.2.1 Physical Environment

#### Janes and Hutchinson Ravines

Janes and Hutchinson Ravines are situated in the northeastern portion of Fort Sheridan. The ravines are deeply incised with 30 to 60 percent slopes caused by the eroding forces of surface water and surficial groundwater draining through the glacial till to Lake Michigan. Compared with other ravines on the installation, Janes Ravine is relatively undisturbed. The steep sides of the ravine are subject to mass wasting (down slope movement of sediment due to gravity), slowed somewhat by the existing vegetation. Surface water drainage is efficient within the ravines due to the excessive slopes. The natural erosion process within the ravine is important in maintaining species diversity by providing sites for colonization of early successional species (U.S. Navy, 1995).

#### Beach Area

The beach landform represents the eastern boundary of the installation where it meets Lake Michigan. The Beach Area study area extends north from Hutchinson Ravine to the mouth of Janes Ravine and ranges from 3 to 10 meters in width. On the west, the beach is bounded by a steep bluff ranging from 40 to 70 feet in height. The beach substrate is composed primarily of sand and includes water rounded rocks. In its natural state, the beach is an eroding shoreline. Groins have been placed from the beach into Lake Michigan to slow the erosion of sand and soils of the steep bluff.

Surface water inflows to Lake Michigan include several major rivers and many minor inflows such as the small streams in the ravines of Fort Sheridan. Important physical features of the lake include its large area and depth which represent a great volume of water, geographic location, climatic effects on regional weather, and its location with respect to socioeconomic centers. Because of the large volume of water contained within Lake Michigan and a relatively low outflow, the residence time of water in the lake is estimated at 100 years (Schelske, 1980). This condition is extremely significant with respect to the quality of constituents that enter the lake and the processes that occur within it.

Many of the inputs to the lake are a result of discharges to the lake and tributary rivers from the highly populated metropolitan and urban areas. Another significant input is from agricultural runoff, occurring mainly in the southern portions of the lake. Water quality in the nearshore zone is distinct from that of the deeper offshore zone. The nearshore zone receives higher nutrient loading from tributaries. Physical processes in the nearshore zone reflect stronger currents and greater interaction between surface water and sediments (Schelske, 1980). The nearshore zone of Lake Michigan has been suggested to include the area from the shore to a depth of 30 meters (approximately 10 kilometers wide) (Mortimer, 1975).

The shoreline of Fort Sheridan is made up of sand- and water-rounded stones and is influenced significantly by erosion of soils of the steep bluffs along the coastline. It is expected that much of the

nearshore habitat is similar to the beach. Lake Michigan contains many rocky areas or reefs, resulting from the retreat of glaciers. Natural reefs may occur in nearshore areas adjacent to Fort Sheridan. However, if not, similar habitat is present in the form of man-made groins extending into the lake to slow erosion of the lake shore substrate. Currents along the shoreline from Milwaukee to Chicago have been measured and move predominantly southward, causing sands to migrate southward and accumulate along the north side of the groins.

The lake bottom is characterized by fine and very fine sand in the shallower depths (11 to 17 meters) and coarse to medium coarse sands at deeper locations with a layer of detritus. A decline of the detrital layer in shallow areas is attributed to resuspension of the material by wave action and redeposition to deeper waters of Lake Michigan (Nalepa and Quigley, 1983).

#### 7.1.2.2 Flora and Fauna

A list of wildlife species potentially occurring or observed at Fort Sheridan is presented in Table 7-20. Most of the area covered by Fort Sheridan reflects the high degree of development. Approximately 86 percent of the installation is developed, supporting office, housing, and training areas and associated support features (roads, parking areas, landfills, etc.). Landscaped areas are artificially maintained and support manicured lawns and horticultural plantings. Approximately 100 acres within Fort Sheridan support natural systems including wooded ravines, beach/lakeshore, and bluff habitat. Because of the high degree of development throughout both the installation and the region, natural resource diversity is observed to be low. The natural areas that remain reflect higher resource values and diversity, especially within the portions of ravines that have not been impacted.

Mammals that are commonly observed throughout Fort Sheridan include raccoon (*Procyon lotor*), Eastern cottontail (*Sylvilagus floridanus*), Eastern chipmunk (*Tamias striatus*), striped skunk (*Mephitis mephitis*), and woodchuck (*Marmota monax*). These species commonly occur in urban and rural areas as they are tolerant of human activity. Similarly, many bird species that utilize urban and rural areas are common throughout the installation.

Most of the installation does not provide suitable habitat to support endangered or threatened terrestrial wildlife species. The limited natural areas of the ravines and undeveloped areas could provide some critical habitat, but the lack of suitable habitat overall precludes the presence of any endangered or threatened mammals, reptiles, or amphibians [Argonne National Laboratory (ANL), 1989]. Thirteen species of special concern were noted during the bird censuses at Fort Sheridan (U.S. Navy, 1995). These included four state endangered species, three state threatened species, and six species on the Illinois Watch List (see Table 7-20). There is also one state threatened species of plant (*Oryzopsis racemosa*, rice grass) reported from the ravines at Fort Sheridan (U.S. Navy, 1995).

### **Janes and Hutchinson Ravines**

The ravines represent habitats of high floral diversity and support a number of tree, shrub, vine, and herbaceous species. The overstory of ravine slopes are composed of sugar maple (*Acer saccharum*), red oak (*Quercus rubra*), and American basswood (*Tilia americana*). Also occurring are American beech (*Fagus grandiflora*), paper birch (*Betula papyrifera*), cottonwood (*Populus deltoides*), and willows (*Salix* spp.). Composition of understory vegetation commonly includes saplings of species found in the canopy as well as witch hazel (*Hamamelis virginica*), smooth juneberry (*Amelanchier laevis*), dogwood (*Cornus alternifolia*), and hornbeam (*Ostrya virginica*). Ground cover species include grasses and forbes including several species of wildflowers. Several State of Illinois listed plant species have been identified as occurring in ravine habitats.

Recent surveys for fauna at Fort Sheridan confirm a nearly complete lack of fish, amphibians, and reptiles in the ravines despite the presence of suitable habitat and the identification of several species in previous studies (U.S. Navy, 1995).

### **Beach Area**

The Beach Area is a long narrow strip between the bluff and Lake Michigan beginning at the mouth of Janes Ravine and extending south to the mouth of Hutchinson Ravine and includes the littoral zone of Lake Michigan. The limited open sandy areas of the beach provide sparse habitat for annual plants that primarily consist of sea rocket and seaside spurge. Avian use of the beach area is primarily by migratory waterfowl, shorebirds, and raptors. Small mammals, such as mice and raccoons, commonly feed along the shoreline of Lake Michigan and along the tributaries that discharge into the lake (primarily Janes and Hutchinson Ravines in the Surplus OU).

### **Lake Michigan**

The aquatic ecological resources of Lake Michigan represent a major economic resource to the region. Benthic invertebrates, phytoplankton, and zooplankton of the nearshore waters provide resources for fish populations which in turn provide resources for predatory fish species. In addition to providing resources for all levels of the food chain, nearshore areas also provide habitat for fish to spawn. While much research has been conducted on the resources of Lake Michigan, little information could be found detailing specific resources in the immediate vicinity of Fort Sheridan. It is believed that no site-specific investigations of the aquatic communities (fauna or flora) adjacent to Fort Sheridan have been conducted. In the absence of such information, it is assumed that communities reported for the southern portion of Lake Michigan potentially occur in the nearshore areas of the lake at Fort Sheridan as well. The southeastern region of Lake Michigan has been the focus of several studies, including the composition of benthic invertebrates. Ecological resources are highly dependent on physical characteristics, which provide habitat resources for reproduction, shelter, or protective cover.

The amphipod *Pontoporeia hoyi* (*P. hoyi*), is the most abundant benthic organism in Lake Michigan (Eadie *et al.*, 1982). This abundant invertebrate constitutes up to 88 percent of the zoobenthic biomass in the upper Great Lakes (Cook, 1975). Because of their great densities and relatively high metabolic rates, these organisms play an integral role in cycling materials through the benthic system (McIntyre, 1969; Gerlach, 1971 and 1978). Lipophilic toxins such as PCBs and PAHs are bioaccumulated by *P. hoyi* to levels much greater than occur in surrounding sediments (Eadie *et al.*, 1983). *P. hoyi* is eaten by a wide variety of fishes and may affect contaminant transfer dynamics in the lakes (Wells, 1980).

Taylor *et al.* (1996) list eight crayfish species as occurring in Lake Michigan, all of which are estimated to sustain currently stable populations. Crayfish occur in nearly every type of aquatic habitat. They are important to aquatic ecosystems in that they facilitate important ecological processes, sustain recreational and commercial bait fisheries, serve as a food source, and often make up a large proportion of the aquatic biomass (Taylor *et al.*, 1996). Crayfish are important as processors of organic matter and in the transformation and flow of energy (Hobbs, 1991). Crayfish are classified as burrowers and non-burrowers. Burrowers inhabit areas not subject to permanent standing water and non-burrowers inhabit permanent surface waters. Crayfish are generally opportunistic omnivores that feed on a wide variety of items including aquatic and terrestrial vegetation, microbially enriched plant detritus, insects, snails, and small aquatic vertebrates (Taylor *et al.*, 1996; Hobbs, 1991). Most crayfish live two to three years (Taylor *et al.*, 1996).

Much information on the commercial and sport fisheries of Lake Michigan has been amassed. Historically, the major fish species of importance in commercial and sport fishing included lake whitefish (*Coregonus culpeaformis*), lake trout (*Salvelinus namaycush*), deepwater ciscoes (*Coregonus johannae*) (now extinct), lake herring (*Coregonus artedii*), lake sturgeon (*Acipinser fulvescens*), yellow perch (*Perca flavescens*), and two introduced species, rainbow smelt (*Osmerus mordax*) and carp (*Cyprinus carpio*). A significant event occurred with the introduction of Alewife (*Alosa pseudoharengus*) into Lake Michigan in 1949. This exotic species proliferated and out competed other species until the introductions of Salmonids, which helped keep the alewife population in check. More recently, incidental introduction of the zebra mussel has caused a serious change in the ecology of Lake Michigan and other waters of the United States. This exotic species is taking over suitable substrates including water intakes of commercial and public industrial facilities and some bottom substrates. The mussel can completely cover bottom substrates, reducing the area over which native and introduced fish species spawn as well as covering areas that would normally produce food resources for fish. In addition, the mussel is responsible for increasing the clarity of lake water by feeding on suspended matter, much of which represents food for other organisms. Current and historically common fish species of Lake Michigan are presented in Table 7-21.

## 7.2 Characterization of Ecological Effects

The determination of the potential or actual ecological effects that are occurring or may occur as a result of exposure to ecoCOPCs is an important component of the ecological risk assessment process. Natural variability in ecosystems is high. Therefore, field observations cannot be presumed to identify a cause (i.e., an adverse effect due to exposure to an ecoCOPC) merely by establishing an apparent deficiency by observation. The characterization presented here relies upon a weight of evidence approach to accurately depict any ecological effects due to exposure to ecoCOPCs within the Surplus OU. This includes field observations, site-specific bioassays and bioaccumulation tests, and ecotoxicity benchmark values from the literature relevant to the chosen assessment endpoints.

### 7.2.1 Ecotoxicity of EcoCOPCs

This section summarizes the ecotoxicity of ecoCOPCs from available literature. Brief summaries are presented below which focus on toxicity relevant to the assessment and measurement endpoints described in Section 6.0.

#### Polycyclic Aromatic Hydrocarbons (PAHs)

Toxicity data specific to sediments were not available for many of the specific PAHs designated as ecoCOPCs for the ravines and Beach Area study areas. Ecologically relevant toxicity benchmark data were available for only a few of the PAH compounds. Benchmarks for benzo(a)pyrene, chrysene, and naphthalene were used as the conservative estimate of the benchmarks for the remaining ecoCOPC PAHs. PAH compounds consist of hydrogen and carbon arranged in the form of two or more fused benzene rings, differing in the number and position of aromatic rings as well as the position of substituents. The PAH ecoCOPCs detected in the ravine and Beach Area sediments range from two to six benzene rings. PAHs of this size are a concern due to their mobility and persistence in the environment. PAHs containing two to three rings (e.g., naphthalenes, fluorenes, phenanthrene, and anthracene) have significant acute toxicity to some organisms (e.g., rats and mice in laboratory tests), whereas heavier weight (four to seven rings) do not. On the other hand, PAHs that are believed to be carcinogenic are among the heavy weight PAHs. Unsubstituted aromatic PAHs with less than four condensed rings have not been shown to be tumorigenic. PAHs in aquatic sediments degrade very slowly in oxygen-poor basins and in anoxic sediments. Available information indicates that PAH compounds can be bioaccumulated by mammals. Most of the readily available PAH bioaccumulation data concern benzo(a)pyrene (Eisler, 1987). In aquatic biota, bioconcentration factors tend to increase with increasing PAH molecular weight. PAH log  $K_{ow}$  is also positively correlated with lipid affinity. National Oceanic and Atmospheric Administration (NOAA) (1990) estimated an effects range-low (ER-L) of 4,000  $\mu\text{g/kg}$  for total PAHs in sediments.



Acenaphthene

Acenaphthene consists of three benzene rings. Available information indicates low acute toxicity to mammals; information concerning chronic toxicity and bioaccumulation potential was not available (Faust, 1994a). The  $K_{ow}$  indicates a moderate affinity for tissue.

Acenaphthylene

Acenaphthylene consists of three benzene rings. Available information indicates low acute toxicity and moderately chronic toxicity to mammals. Information concerning bioaccumulation was not available (Faust, 1994b). The  $K_{ow}$  and  $K_{oc}$  indicate a moderate affinity for carbon and tissue.

Benzo(a)anthracene

Benzo(a)anthracene consists of four benzene rings. Information concerning specific toxicity was not available, but a bioconcentration factor (BCF) of >10,000 has been reported for *Daphnia pulex* (Eisler, 1987). The USEPA interim mean freshwater sediment quality criteria (SQC) based upon equilibrium partitioning (assuming 1 percent TOC) is 13,200  $\mu\text{g}/\text{kg}$ . On the other hand, the ER-L is 230 parts per billion (ppb) (NOAA, 1990).

Benzo(a)pyrene

Benzo(a)pyrene consists of five benzene rings. A BCF of 166 was measured for *Chironomus* larvae, and a BCF of > 82,000 was observed in snails (Eisler 1987). The USEPA interim SQC (at 1 percent TOC) is 10,630  $\mu\text{g}/\text{kg}$ , and the observed ER-L is 430  $\mu\text{g}/\text{kg}$  (USEPA, 1996d). Available information indicates low chronic toxicity to mammals (mice). For example, an acute oral medial lethal dose ( $\text{LD}_{50}$ ) of 50 milligrams per kilogram ( $\text{mg}/\text{kg}$ ) has been reported for rodents. Information concerning bioaccumulation in terrestrial organisms was not available (Faust, 1994c).

Benzo(b)fluoranthene

Benzo(b)fluoranthene consists of five benzene rings. Information concerning toxicity and bioaccumulation was not available.

Benzo(g,h,i)perylene

Benzo(g,h,i)perylene consists of six benzene rings. Information concerning toxicity and bioaccumulation was not available.

Benzo(k)fluoranthene

Benzo(k)fluoranthene consists of five benzene rings. Information concerning toxicity and bioaccumulation was not available.

### Chrysene

Chrysene consists of four benzene rings. Little information concerning toxicity and bioaccumulation was available. NOAA (1990) reports an ER-L of 400  $\mu\text{g/kg}$  for chrysene. However, the sediment safe value for acute effects is 115,000  $\mu\text{g/kg}$  based upon equilibrium partitioning.

### Dibenzo(a,h)anthracene

Dibenzo(a,h)anthracene consists of five benzene rings. Information concerning ecotoxicity and bioaccumulation for terrestrial organisms was not available. The sediment safe value for acute effects is reported as 240,000  $\mu\text{g/kg}$  based upon equilibrium partitioning. However, the ER-L is 60  $\mu\text{g/kg}$  (NOAA, 1990).

### Fluoranthene

Fluoranthene consists of four benzene rings. The available data indicates low acute toxicity of fluoranthene to mammals. An acute oral  $\text{LD}_{50}$  of 2,000 mg/kg has been reported for rats. Information concerning bioaccumulation is not available. The USEPA interim SQC is 2,900  $\mu\text{g/kg}$  calculated by equilibrium partitioning with an assumed TOC of 1 percent (Faust, 1993a).

### Indeno(1,2,3-cd)pyrene

Indeno(1,2,3-cd)pyrene consists of six benzene rings. Information concerning toxicity and bioaccumulation was not available.

### 1-Methylnaphthalene and 2-Methylnaphthalene

Little information concerning these two PAH compounds was available. Comparisons of ecotoxicity benchmark values for marine species tested with 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene suggest a relative toxicity of naphthalene < 1-methylnaphthalene < 2-methylnaphthalene; however, the toxicity of these three compounds is similar (Eisler, 1987). Some data suggest that bioaccumulation potential increases with increasing methylation. An ER-L of 65  $\mu\text{g/kg}$  is reported for 2-methylnaphthalene (NOAA, 1990).

### Naphthalene

Naphthalene consists of two benzene rings. An ER-L of 340  $\mu\text{g/kg}$  is reported (NOAA, 1990). Eisler (1987) reports a BCF for *Daphnia pulex* of 131. Available data indicate low acute and chronic toxicity to mammals (Faust, 1993b). In one set of studies, an acute oral  $\text{LD}_{50}$  for rats was reported at 2,300 mg/kg, and for mice was reported at approximately 600 mg/kg. In a chronic study, rats were fed 10 to 20 mg/rat/day for 600 days with no mortality. In another study, mallard ducks were fed 4,000 mg PAH/kg food for 7 months with no mortality or visible signs of toxicity. In this study, the PAHs were mostly naphthalenes and phenanthrene (Eisler, 1987). Information concerning bioaccumulation in terrestrial organisms was not available, but the log  $K_{ow}$  would predict a relatively low potential.

### Phenanthrene

Phenanthrene consists of three benzene rings. The ER-L was determined to be 225  $\mu\text{g}/\text{kg}$ . However, the USEPA interim SQC is 850  $\mu\text{g}/\text{kg}$  based upon equilibrium partitioning and 1 percent TOC (USEPA, 1996d). A BCF of 325 has been reported for *Daphnia pulex* (Eisler, 1987). Available information indicates low acute toxicity of phenanthrene to mammals (mice). An acute oral  $\text{LD}_{50}$  was reported as 700  $\text{mg}/\text{kg}$  for rodents. Information concerning chronic toxicity and bioaccumulation was not available (Faust, 1993c).

### Pyrene

Pyrene consists of four benzene rings. The USEPA interim SQC is 13,100  $\mu\text{g}/\text{kg}$ , while the ER-L is 660  $\mu\text{g}/\text{kg}$  (Faust, 1993d). Information concerning terrestrial toxicity and bioaccumulation is not available.

### Pesticides

The pesticides identified as ecoCOPCs in the ravine and Beach Area abiotic media are p,p'-DDD, p,p'-DDE, and p,p'-DDT. DDD and DDE are metabolites of DDT, which is a well-documented organochlorine insecticide. The majority of the relevant ecotoxicity data located for the pesticide ecoCOPCs is for p,p'-DDT. When data were not available for the other two DDT metabolites, information for p,p'-DDT was used for those compounds. DDT and its metabolites are readily absorbed to sediments, which can act as a sink or long term source. DDT can be bioaccumulated from an organism's surrounding medium (e.g., water or sediment) or its food. Body burdens tend to increase with increasing trophic level. For aquatic organisms, uptake from water is frequently the dominant pathway. However, in terrestrial fauna, the dietary pathway generally predominates. Since these compounds are resistant to breakdown, they can persist for long periods in the environment as well as the tissue of living organisms. DDT and its metabolites are toxic to aquatic invertebrates, especially the early larval stages, in short-term and chronic exposures. Larval amphibians also appear more sensitive than adults. DDE and DDD both appear to be less toxic to aquatic organisms than DDT. NOAA (1990) ER-Ls have been determined for each: 2.0  $\mu\text{g}/\text{kg}$  for both DDD and DDE, and 1.0  $\mu\text{g}/\text{kg}$  for DDT. An ER-L of 1.6  $\mu\text{g}/\text{kg}$  is presented as a national screening level for total DDTs in freshwater sediments. Data indicate that DDT is accumulated and retained by wild mammals. Data concerning toxic effects on wild mammals is limited mostly to bats, but does suggest that DDT can have toxic effects on mammals [World Health Organization (WHO), 1989].

Aldrin is another pesticide that is acutely toxic to freshwater species at low concentrations, with rainbow trout among the most sensitive fish species tested. Aquatic plants are not as sensitive to aldrin. In terrestrial mammals, aldrin acts as a central nervous system stimulant.

Chlordane, an insecticide, may act as a neurotoxin. Bioaccumulation of chlordane is limited.

## Metals

### Aluminum

Aluminum is a silver-white, flexible metal and a natural element in the earth. It is always found combined with other elements, such as ores. It is used in several different forms. These forms include aluminum chloride, aluminum nitrate, aluminum hydroxide (used in antacids), aluminum chlorohydrate (used in deodorants), and aluminum sulfate (used for treatment of drinking water). The concentration of aluminum in natural waters and drinking water is generally below 0.1 mg/L (ATSDR, 1997).

In lower pH environments, aluminum is more available and is generally considered more toxic to aquatic organisms. An aluminum level of 2.6 mg/L caused reductions in reproduction and survival of a freshwater cladoceran (*Ceriodaphnia dubia*). Weight reductions were reported for fathead minnows (*Pimephales promelas*) exposed to aluminum at 2.3 and 4.7 mg/L. Aluminum was found to bioconcentrate in tests conducted with juvenile brook trout; however, data are insufficient to adequately characterize the potential for bioaccumulation (USEPA, 1988c). The EPA chronic ambient water quality criterion for aluminum is 87 µg/L.

Aluminum is not especially toxic in aquatic systems at circumneutral pH, but toxicity increases with decreasing pH. Aluminum may be translocated into plants, and aluminum may be phytotoxic to some crops at concentrations as low as 4 mg/kg (USEPA, 1983b).

### Arsenic

Arsenic is a silver-gray or white metallic solid and not considered an essential nutrient. Arsenic is found in nature, predominantly in sulfide ores. Although arsenic is rarely encountered in natural waters as a free element, most arsenic compounds are soluble in water. Arsenic is typically non-biodegradable. However, it can change from one form to another by natural constituent reactions, and also by the action of bacteria that live in water. Although some fish and shellfish build up arsenic in their tissues, most of this is in a form (often called "fish arsenic") that is not toxic. (ATSDR, 1997).

Effects observed in wildlife may be similar to those in livestock that have ingested arsenic. Chronic toxicosis from phenylarsonic compounds involves peripheral nerve degeneration, which may result in quadriplegia (Ledet *et al.*, 1973). For chickens, the lowest oral lethal dose of trivalent arsenic as arsenic trioxide and sodium arsenite reported is 50 and 10 mg/kg-bw/day, respectively. These are equivalent to doses of 15 and 2.3 mg/kg/day (Hatch, 1977). For wild rabbits, a toxic dose of 10.5 mg/kg-bw arsenic was reported for copper acetoarsenite. However, the copper may play a role in the reported toxicity, as higher doses were reported for other arsenic compounds (ESE, 1989). White-tailed deer evidenced toxicity at a total dose of 923 mg sodium arsenite. For mice, Gough *et al.* (1979) report a 96-hour LD<sub>50</sub> of 11.2 mg/kg-feed, which is equivalent to 1.6 mg/kg/day.

### Barium

Barium is an earth metal and does not occur free in nature. It is present in igneous rock and is a natural constituent of fossil fuels.

Barium is present in almost all surface waters and contributes to the hardness of the water. Transport of barium in water is subject to interaction with other ions. Therefore, information regarding the transport of barium is limited (HSDB, 1997). The median lethal concentration ( $LC_{50}$ ) values for fish in fresh water range from 46 to 78 mg/L (WHO, Environmental Health Criteria 107, 1990). Based on limited available information, it seems that barium may adversely affect some aquatic organisms.

In the rat, acute oral  $LD_{50}$  values of 118, 250, and 355 mg/kg-bw were measured for barium chloride, fluoride, and nitrate, respectively [National Institute of Occupational Safety and Health (NIOSH), 1985]. The acute effects of barium ingestion include salivation, nausea, diarrhea, tachycardia, hypokalaemia, twitching, flaccid paralysis of skeletal muscles, respiratory muscle paralysis, and ventricular fibrillation. Respiratory muscle paralysis and ventricular fibrillation may cause death.

### Copper

Copper is a minor nutrient for animals but is toxic to freshwater aquatic organisms at concentrations only slightly higher. Data for several freshwater species indicates that the toxicity of copper in water decreases with increasing hardness, alkalinity, and total organic carbon. Bioaccumulation potential ranges from low (fish) to moderately high (alga and mollusk species) (USEPA, 1985). Available data for mammals indicate acute toxicity at elevated levels. Information concerning bioaccumulation by mammals is not available. The USEPA Region V guideline for pollution classification of sediments and the OME dredge spoil guidelines are 25 mg/kg for copper. The Great Lakes Harbors (GLH) classification for nonpolluted sediments is <25 mg/kg (NOAA, 1990).

### Lead

Lead, a soft metal, is strongly absorbed onto sediment particles, which reduces its availability to terrestrial organisms. The toxicity of lead to wildlife is not well-documented. Lead tends to precipitate out of complex solutions due to low solubility and remains tightly bound to sediment particles in aquatic systems (WHO, 1989). Data indicate a low to moderate toxicity of lead to aquatic organisms (e.g., daphnids, snails). The potential for bioaccumulation of lead in aquatic and aquatic/terrestrial systems is reduced when organic material and sediment are present. In many organisms, it appears that lead may be absorbed rather than bioaccumulated (WHO, 1989). The GLH classification for nonpolluted sediments is <40 mg/kg and the USEPA Region V guidelines for pollution classification of sediments is 40 mg/kg. The OME guideline is 50 mg/kg. The Federal Water Pollution Control Association (FWPCA) Chicago guideline for no alteration to benthos is 0 to 40 mg/kg (NOAA, 1990).

### Mercury

Mercuric salts and methylmercury are readily taken up by organisms, but elimination is much faster for nonorganic forms. In aquatic systems, most of the mercury present in fish can be expected to be methylated. However, in terrestrial systems, the proportion of inorganic mercury is greater, dependent upon the extent of terrestrial organisms feeding on aquatic organisms. In aquatic systems, organic forms of mercury are generally more toxic than inorganic forms, and toxicity is affected by salinity, water hardness, temperature, and dissolved oxygen. Plants are generally unaffected by exposure to mercury, but birds exhibit growth reduction from oral ingestion of mercury.

### Nickel

Nickel is a trace metal that tends to remain bound to sediment and organic matter, but can be released from sediment under particular physical/constituent conditions. The ER-L was estimated as 30 mg/kg. The GLH classification for nonpolluted sediments is <20 mg/kg and the USEPA Region V guidelines for pollution classification of sediments is 20 mg/kg (NOAA, 1990). The OME guideline is 25 mg/kg. Few data are available regarding any toxic effects of nickel on terrestrial organisms. Data regarding the potential for bioaccumulation of nickel by terrestrial organisms are limited to herbivorous organisms for which there is some evidence of bioaccumulation. Data for aquatic organisms indicate that biomagnification is unlikely (WHO, 1991).

### Silver

Silver is a relatively rare element, occurring most commonly as elemental silver and the monovalent silver ion, and is insoluble in water (Faust, 1992). The lowest chronic values for silver regarding fish and daphnids are 0.12 and 2.6  $\mu\text{g/L}$ , respectively (Suter II, 1996). Acute toxicity of silver to terrestrial animals appears to be high, with oral  $\text{LD}_{50}$  values of 100 mg/kg (colloidal silver) and 125 mg/kg (silver nitrate) for mice. The oral  $\text{LD}_{50}$  of silver cyanide to rats is 125 mg/kg. The results of one study indicated that a long-term exposure (37 weeks) to 222 mg silver/kg/day in drinking water resulted in reduced lifespan and growth of rats (Faust, 1992). The Region III BTAG screening level BCF value for fish is 150, indicating a relatively low potential for bioaccumulation of silver.

### Vanadium

Vanadium is relatively insoluble in water. Limited information on the toxic effects to aquatic organisms is available. A growth-feeding trial was conducted by Hilton and Bettger (1988) in which juvenile rainbow trout were fed diets supplemented with 0 to 10 grams vanadium per kg diet for 12 weeks. All levels of supplemented vanadium significantly reduced growth and feeding response in the trout. An  $\text{LC}_{50}$  value of <0.16  $\mu\text{g/L}$  was determined for a 96-hour study (USEPA, 1985) and chronic toxicity (5- to 28-day  $\text{LC}_{50}$ ) was noted at approximately 2,000  $\mu\text{g/L}$ . The literature typically indicates that vanadium is better tolerated by small animals than larger bodied animals. Laboratory rats given a dose of 0.05 to 0.5 mg/kg/day developed impairment of conditional reflexes over an 80-day period (Seljankina, 1961).

### Zinc

Zinc is one of the most mobile of the heavy metals and can occur in many forms in aquatic sediments. The bioavailability of the different forms of zinc in sediments is not well-documented. Zinc is an essential micronutrient for all organisms and is, therefore, readily accumulated. Only data for aquatic organisms is available and indicates a moderate to high potential for bioaccumulation of zinc (USEPA, 1987). The GLH classification for nonpolluted sediments is <90 mg/kg and the USEPA Region V guidelines for pollution classification of sediments is 90 mg/kg. The FWPCA Chicago guideline for no alteration to benthos is 0 to 90 mg/kg (NOAA, 1990).

### Other Constituents

#### Carbazole

Carbazole is a semi-volatile organic compound that is insoluble in water. The only information concerning the toxic effects of carbazole is dated and was not used as a benchmark. However, this information does indicate that the toxicity of carbazole to mammals is low (Windholz *et al.*, 1976). Information regarding bioaccumulation potential for terrestrial mammals was not available.

#### Chloride

Chloride is generally identified as a problem in surface waters due to anthropogenic sources such as deicing salts. Invertebrates are generally more sensitive than vertebrates. There is no evidence that bioaccumulation of chloride poses a problem.

#### Decachlorobiphenyl

PCBs are currently released to the environment from landfills containing PCB waste materials and products, incineration of municipal refuse and sewage sludge, and improper disposal of PCB materials. PCBs are mixtures of different congeners of chlorobiphenyl. The relative importance of the environmental fate mechanisms generally depends on the degree of chlorination. In general, the persistence of PCBs increases with an increase in the degree of chlorination. Mono-, di- and trichlorinated biphenyls (Aroclor 1221 and 1232) biodegrade relatively rapidly. Tetrachlorinated biphenyls (Aroclors 1016 and 1242) biodegrade slowly. Higher chlorinated biphenyls (Aroclors 1248, 1254, and 1260) are resistant to biodegradation (HSDB, 1997).

PCBs are notable for their persistence in the environment. PCBs can be transformed by photochemical and microbial processes. However, the rates are very slow, particularly for higher chlorinated biphenyls, such as decachlorobiphenyl. Under reducing conditions, however, the components of PCBs have been shown to dehalogenate, forming less chlorinated PCBs that can, in turn, be biodegraded under aerobic conditions. The environmental persistence of PCBs is demonstrated by their frequent occurrence in environmental samples, even though production of these constituents has been prohibited since 1977. PCBs have been shown to bioconcentrate significantly in aquatic organisms. There are no specific

toxicity values available for decachlorobiphenyl; however, an oral PCB LD<sub>50</sub> of 11 grams per kilogram (g/kg) has been determined for rats (HSDB, 1997).

### 1,3-Dinitrobenzene

1,3-Dinitrobenzene is one of the many nitroaromatic compounds that are used in the manufacture of dyes, explosives, industrial solvents, and pesticides and, thus, may be released to the environment as a result of such uses. 1,3-Dinitrobenzene may biodegrade in water and volatilization may occur. However, biodegradation is expected to be slow. While direct photolysis may occur, sufficient information is not available to estimate a rate. Bioconcentration and hydrolysis are not expected to be significant because of low estimated bioconcentration factors and the lack of hydrolyzable groups, respectively (HSDB, 1997). Oral LD<sub>50</sub> toxicity values for 1,3-dinitrobenzene of 74.7, 59.5, and 42 mg/kg were determined for the mouse, rat and bird, respectively (NIOSH, 1997).

### Sulfate

Sulfate is present in inorganic compounds and salts formed with metal cations. Sulfates occur naturally in the environment in sediments, and rocks. They also may enter surface waters through acid rain (sulfuric acid levels increase) or through disposal of wastes containing sulfates.

Animal studies suggest that sulfate is not mutagenic, carcinogenic, or teratogenic in mammals. The current EPA national secondary drinking water standard for sulfate is 250 mg/L based on taste and odor. The WHO has recommended an upper limit of 400 mg/L in drinking water [40 Code of Federal Regulations (CFR) Part 141].

### Trichlorofluoromethane

Trichlorofluoromethane is a VOC that is relatively insoluble in water (Windholz *et al.*, 1976). Aquatic toxicity information is limited to an acute lower exposure concentration (LEC) of 11,000 µg/L (USEPA, 1998) for freshwater. Data concerning toxic effects and bioaccumulation potential for terrestrial mammals is not available.

## **7.2.2 Site-Specific Study Results**

Bioassay tests were run on two invertebrate and one vertebrate species.

### **7.2.2.1 Site-Specific Sediment Bioassay Study Results**

Chronic toxicity tests were conducted with freshwater invertebrates to evaluate toxicity of ecoCOPCs contained within sediment collected from Janes and Hutchinson Ravines and their respective outflow areas along the Beach Area. Bioaccumulation of ecoCOPCs by aquatic invertebrates in ravine and Beach Area sediments is also a potential pathway for exposure at Janes and Hutchinson Ravines and their



discharge areas. Chronic toxicity and bioaccumulation tests using site-specific sediment samples collected from the ravines and Beach Area are discussed in the following paragraphs.

#### *H. azteca*

Whole sediment toxicity tests were conducted with the freshwater invertebrate, *H. azteca*, on samples collected from both Janes and Hutchinson Ravines. The effect criteria for the tests were survival and growth (length and dry weight).

A total of three sediment samples from Janes Ravine (JRBSD01, JRBSD02, and JRBSD03), two background sediment samples from the north arm of Janes Ravine (JRBSD04 and JRBSD05), and one laboratory control were used in the toxicity tests. After 28 days of exposure, there were no significant differences ( $P \leq 0.05$ ) in the survival of *H. azteca* between the laboratory control sediment (94 percent) and the background sediment samples (91 and 94 percent). Also, there were no significant differences ( $P \leq 0.05$ ) in the survival of *H. azteca* between the background sediments and the three site sediment samples. Survival in sediments JRBSD01, JRBSD02, and JRBSD03 was 99, 96, and 99 percent, respectively. Growth, as dry weight and length, of *H. azteca* in the background sediments was not significantly different ( $P \leq 0.05$ ) from the laboratory control. After the 28-day exposure, there were no significant differences ( $P \leq 0.05$ ) in the growth of *H. azteca* between the background sediments and the three Janes Ravine sediment samples: JRBSD01, JRBSD02, and JRBSD03.

A total of three sediment samples from Hutchinson Ravine (HRBSD01, HRBSD02, and HRBSD03), two sediment samples from the northern arm of Hutchinson Ravine (HRBSD04 and HRBSD05), one background sediment sample from the upper end of Shenck Ravine (SRBD01), and one laboratory control were used in the toxicity tests. After 28 days of exposure, there were no significant differences ( $P \leq 0.05$ ) in the survival of *H. azteca* between the laboratory control sediment (94 percent) and the background sediment (94 percent). Also, there were no significant differences ( $P \leq 0.05$ ) in the survival of *H. azteca* between the background sediment and the three Hutchinson Ravine sediments. Survival in the Hutchinson Ravine sediments ranged from 88 to 100 percent. Growth, as dry weight and length, of *H. azteca* in the background sediment was not significantly different ( $P \leq 0.05$ ) from the laboratory control. After the 28-day exposure, there were no significant differences ( $P \leq 0.05$ ) in the growth of *H. azteca* between the background sediment and the five site sediments: HRBSD01, HRBSD02, HRBSD03, HRBSD04, and HRBSD05.

#### *L. variegatus*

Flow-through whole sediment bioaccumulation tests were conducted with the freshwater invertebrate, *L. variegatus*, on sediment samples collected from Janes and Hutchinson Ravines. The effect criteria for the tests were survival and adequate tissue for constituent analyses. The tests consisted of five replicate chambers per sediment sample (16 grams of *L. variegatus* per replicate), with each chamber containing

approximately 3.0 kg of sediment and 8.0 liters of overlying water. Each chamber received two volume additions of overlying water per day during the 28-day exposure period. After 28 days of exposure, the test organisms were held in fresh overlying water for 24 hours to allow the organisms to purge their gut contents. At the conclusion of the 24-hour purge, constituent analyses of the *L. variegatus* tissue were performed for metals, explosives, semivolatile organic compounds, pesticides, and PCBs. For each sediment, the organisms from the five replicate chambers were pooled together to provide sufficient tissue mass for the constituent analyses (i.e., the constituent analyses were not replicated).

One sediment sample from Janes Ravine (JRBSD01), one background sediment sample from the north arm of Janes Ravine (JRBSD04), and one laboratory control were used in the bioaccumulation tests for Janes Ravine. After 28 days of exposure, a sufficient mass of *L. variegatus* tissue was collected for constituent analyses from the laboratory control, background sediment, and Janes Ravine sediment. Survival of *L. variegatus* in sediment JRBSD01, based on the amount of tissue recovered, was greater than survival in the laboratory and background exposures. No abnormal behavior or dead organisms were observed in sediment Sample JRBSD01 during the test.

One site sediment sample from Hutchinson Ravine (HRBSD01), one background sediment sample from the north arm of Janes Ravine (JRBSD04), and one laboratory control were used in the bioaccumulation tests for Hutchinson Ravine. After 28 days of exposure, a sufficient mass of *L. variegatus* tissue was collected for constituent analyses from the laboratory control, background sediment, and the Hutchinson Ravine sediment. Survival of *L. variegatus* in sediment Sample HRBSD01, based on the amount of tissue recovered, was greater than survival in the laboratory and background exposures. No abnormal behavior or dead organisms were observed in sediment Sample HRBSD01 during the test.

Two sediment samples from the beach outflow areas of Janes and Hutchinson Ravines (JRBSD06 and HRBSD06), one background sediment from Boles Loop Drain (BLBSD01) and one laboratory control were used in the bioaccumulation tests for the Beach Area. After 28 days of exposure, a sufficient mass of *L. variegatus* tissue was collected for constituent analyses from the laboratory control, background sediment sample, and the ravine sediment samples. Survival of *L. variegatus* in sediment Samples JRBSD06 and HRBSD06, based on the amount of tissue recovered, was greater than survival in the laboratory control and less than survival in the background sediment sample. The reduction in survival/tissue mass is most likely due to the sterile nature of the beach sediments. No abnormal behavior or dead organisms were observed in sediment Samples JRBSD06 and HRBSD06 during the test.

Constituent concentrations in *L. variegatus* tissue samples were evaluated for each study area to determine which sediment ecoCOPCs had bioaccumulated in the tissue samples. Because examination by study area resulted in small sample sizes, data were not statistically compared to background. Concentrations of sediment ecoCOPCs that were detected in *L. variegatus* tissue samples were compared

graphically by study area [i.e., Janes Ravine (Figure 7-1), Hutchinson Ravine (Figure 7-2), and the Beach Area (Figure 7-3)]. While some constituents had higher concentrations in the *L. variegatus* tissue samples from the study areas compared with the background tissue samples (e.g., DDT and derivatives), these differences may not be significant. Such observed differences may reflect subtle differences between the study area and background sampling locations that influence bioaccumulation.

Bioaccumulating constituents consisted of metals and pesticides. The tissue data were reviewed for constituents that had potentially bioaccumulated or have a significant potential for bioaccumulation but which had not been identified as ecoCOPCs in sediments, to determine if additional constituents should be evaluated for exposure through the food web. As a result of this evaluation, the following constituents were also evaluated for exposure through the food web: (1) selenium and zinc in Hutchinson Ravine; (2) cadmium, chromium, mercury, and selenium in Janes Ravine; and (3) cadmium, chromium, and selenium at the Beach Area.

The zebra mussel, which has spread ubiquitously in the Great Lakes, efficiently filters phytoplankton and detritus from surface waters and bioaccumulates chemicals such as metals, PAHs, PCBs, and pesticides. These organisms are effective biomonitors because of their ability to rapidly accumulate industrial pollutants (de Kock and Bowmer, 1993). Among the metals, cadmium and selenium have been shown to accumulate to unacceptable levels in other aquatic systems (Secor *et al.*, 1993). However, exposure concentrations were not reported. In another study completed at a site in New York, PAHs, PCB Aroclor 1248, arsenic, chromium, and barium accumulated to levels in zebra mussel tissue that represented a potential hazard to fish and birds feeding upon them (Roper *et al.*, 1996). However, sediment exposure concentrations at this site were also reported to be much higher than those observed in Lake Michigan sediments (one to two orders of magnitude higher for metals, and several orders of magnitude higher for organics). Based upon the potential exposure concentrations of ecoCOPCs in Lake Michigan sediments, one would not expect tissue body burdens in zebra mussels to reach levels predicted to represent a concern to fish or birds. This evaluation is consistent with the results of the site-specific bioaccumulation studies with *L. variegatus*.

#### 7.2.2.2 Site-Specific Groundwater Bioassay Study Results

Definitive static-renewal acute toxicity tests were conducted with the fathead minnow, *P. promelas*, using groundwater samples which are evaluated as part of the Beach Area. The effect criterion for the acute toxicity tests was survival. The 96-hour, static-renewal test of each groundwater sample consisted of two replicates per test concentration (20 organisms per concentration), with each test vessel containing 200 mL of test solution. The test concentrations were 0 (dilution water control), 6.25, 12.5, 25, 50, and 100 percent groundwater. The dilution water was moderately hard reconstituted water prepared from deionized water.

Three groundwater samples were collected downgradient of the Beach Area at monitoring Wells LF2MW06S, LF2MW08S, and LF2MW09S. Three background samples were also collected from Fort Sheridan monitoring Wells BGMW02, BGMW03, and BGMW04. After 96 hours of exposure, mortality in the control exposure was 0 percent. Survival of *P. promelas* in the five test concentrations of the Beach Area and background water samples ranged from 90 percent (100 percent LF2MW09S groundwater) to 100 percent (100 percent BGMW04 groundwater). There was no significant difference ( $p \leq 0.05$ ) in mortality between the laboratory control and any of the Beach Area or background water samples. Under the conditions of the study, the 96-hour  $LC_{50}$  values for the groundwater samples were greater than 100 percent, indicating that neither the study area nor background samples were acutely toxic to *P. promelas*.

### 7.2.3 Stressor-Response Profile

The stressor-response profile summarizes the ecotoxicity benchmark values and/or site-specific data that apply to the chosen measurement endpoints. Variables used to determine benchmark values and evaluate risk characterization for terrestrial wildlife are presented in Tables 7-22 through 7-29.

#### 7.2.3.1 Measurement Endpoint 1--Benchmarks for Surface Water Ingestion by Terrestrial Mammals

Benchmarks for surface water ingestion by mice, woodchucks, and raccoons were calculated for as many surface water ecoCOPCs as possible utilizing test endpoints for other mammalian organisms (e.g. rats and mice). The chronic endpoints (Original Endpoint Value) used for each of the benchmarks were the LOAEL and/or the NOAEL located during a search of the literature. The source for the test endpoints was Toxicological Benchmarks for Wildlife: 1996 Revision (ES/ER/TM-86/R3).

The Original Endpoint Value (mg/kg/day) for the Test Organism (rat or mink) was converted to an Endpoint Wildlife Value (mg/kg/day) for the four terrestrial mammals using the following equation:

$$\text{Endpoint Wildlife Value} = \text{Original Endpoint Value} * (bw_t / bw_w)^{1/4}$$

where:  $bw_t$  = Test Organism body weight (kg)  
 $bw_w$  = endpoint Wildlife (terrestrial mammal) body weight (kg)

The Endpoint Wildlife Value for the terrestrial mammals was then converted into a surface water benchmark (mg/L), representing the concentration of an ecoCOPC in surface water that is a dose equivalent of the Endpoint Wildlife Value. Surface water benchmarks were calculated using the following equation:

$$\text{Surface Water Benchmark} = \text{Endpoint Wildlife Value (terrestrial mammal)} * bw_w / IR_w$$

where:  $IR_w$  = water consumption rate (L/day) for the particular terrestrial mammal

The final surface water benchmarks for ingestion of surface water ecoCOPCs by the four terrestrial mammals, as well as the factors used in the above calculations, are presented in Table 7-30. As noted in the ecotoxicity discussion (Section 7.2.1), relevant and appropriate ecotoxicity benchmark values were not available for every ecoCOPC. The constituent surrogates used for ecoCOPCs in cases where appropriate benchmarks for the ecoCOPC were not identified from the literature are also presented in Table 7-30.

#### 7.2.3.2 Measurement Endpoint 2--Benchmarks for Amphibians

Amphibians are sensitive bioindicators of environmental stress or change due to their permeable skin and biphasic development. Early life stages are particularly sensitive to environmental conditions. A literature search was performed to locate toxicological information on the effects of constituent constituents and physical properties of the environment on amphibians. The initial search produced articles discussing the effects of acidification/pH, metals, alcohols, pesticides, SVOCs, VOCs, and petroleum products on amphibian embryo and larval development. Any numeric toxicity values, such as  $LC_{50}$ s and NOAELs, and general effects, such as a reduction in biomass, located in the articles were pooled into a spreadsheet. Based on ravine and Beach Area data, information related to pH was eliminated from the database since the pH at the study areas was determined to be neutral. The database was then reduced to only data points related to surface water ecoCOPCs. Data on the effects of the surface water ecoCOPCs on amphibians is presented in Table 7-31.

#### 7.2.3.3 Measurement Endpoint 3--Site-Specific Groundwater Bioassays and Benchmarks for Aquatic Invertebrates

Site-specific bioassays with fathead minnows, *P. promelas*, were performed using groundwater samples evaluated as part of the Beach Area study area. Groundwater bioassays were performed for a 96-hour period to determine toxicity to aquatic species. Toxicity tests using groundwater determined that ecoCOPCs present in the groundwater are not acutely toxic to the test species. Additionally, chronic toxicity values for aquatic invertebrates (primarily daphnid species) were located for ravine surface water ecoCOPCs and are presented in Table 7-32.

#### 7.2.3.4 Measurement Endpoint 4--Site-Specific Sediment Bioassays and Sediment Ecotoxicity Benchmark Values for EcoCOPCs in Lake Michigan Sediments

Site-specific bioassays were performed for 28 days using sediment samples collected from Janes Ravine, Hutchinson Ravine, and the Beach Area. Test organisms for the bioassays included the amphipod, *H. azteca*, and the blood worm, *L. variegatus*. Two types of bioassays were conducted using these test species to determine if the ecoCOPCs present in ravine sediments are toxic over a 28-day period to benthic invertebrates and/or bioavailable. Survival and growth results of the *H. azteca* toxicity tests

determined that ecoCOPCs present in the ravine sediment samples were not chronically toxic to the test species. Bioaccumulation results of the *L. variegatus* toxicity tests determined that ecoCOPCs present in the ravine sediment samples were not chronically toxic to the test species and had not bioaccumulated to toxic levels. Tissue body burden results were also used to evaluate the potential for food web exposure (see Section 7.2.3.6). Because no site-specific bioassays were performed using sediment from Lake Michigan, ecotoxicity benchmarks were obtained from the literature for benthic invertebrates that may be exposed to lake sediment constituents. Ecotoxicity benchmarks for benthic invertebrates are presented in Table 7-33.

#### 7.2.3.5 Measurement Endpoints 5 and 6--Dietary Benchmarks for Incidental Sediment Ingestion by Raccoon and the Common Snipe

Ecotoxicity benchmarks for sediment ecoCOPCs that may be incidentally consumed by small mammal and avian species during preening, feeding, and other activities at the ravines and Beach Area are presented in Tables 7-34 and 7-35. In general, representative ecotoxicity benchmark values for ecoCOPCs are identified from the literature and converted to the wildlife species of interest (see discussion below) utilizing site-specific exposure assumptions. The chronic endpoint (original endpoint value) used for the ecotoxicity benchmarks was a LOAEL or a NOAEL. Extrapolation within classes of organisms, although containing some inherent uncertainty, is a generally accepted practice (as described below). On the other hand, extrapolations between phylogenetic Classes is more uncertain, and the reliability of such extrapolations is unknown. Extrapolations from mammalian benchmarks to avian benchmarks may underestimate toxicity when based solely on body weight (EPT, 1996). Ecotoxicity benchmark values for some ecoCOPCs were not readily available in the literature for avian receptors. For estimation of avian oral toxicity for these ecoCOPCs, a regression technique was employed (Shortelle *et al.*, 1997), and the results are presented in Table 7-36 for antimony in Beach Area sediments.

The source for the benchmark calculation is the *Toxicological Benchmarks for Wildlife: 1996 Revision* (ES/ER/TM-86/R3). The Original Value (mg/kg/day) for the Test Organism was converted to an Endpoint Wildlife Value (mg/kg/day) for the species of concern using the following equation:

$$\text{Endpoint Wildlife Value} = \text{Original Value} * (\text{bw}_t / \text{bw}_w)^{1/4}$$

where:  $\text{bw}_t$  = Test Organism body weight (kg)

$\text{bw}_w$  = Endpoint Species (Species of Concern) body weight (kg)

The Endpoint Wildlife Value for the avian and small mammal species was then converted to an intake benchmark (mg/kg), representing the concentration of an ecoCOPC in food that is a dose equivalent of the Endpoint Wildlife Value. Intake benchmarks were calculated using the following equation:

$$\text{Sediment Intake Benchmark} = \text{Endpoint Wildlife Value} / f$$

where:  $f$  (food factor) =  $IR_s / bw_w$   
 $IR_s$  = sediment consumption rate (kg/day) for species

The final benchmarks for ingestion of ecoCOPCs by the common snipe and the raccoon, as well as factors used in the above calculations and any constituent surrogates used to determine the benchmarks, are presented in the tables as identified above. As noted in the ecotoxicity discussion (Section 7.2.1), relevant and appropriate ecotoxicity benchmark values were not available for every ecoCOPC.

#### 7.2.3.6 Measurement Endpoint 7--Dietary Benchmarks for Ingestion of Forage and Prey (Food Web Exposure)

Benchmarks for ecoCOPCs that may be consumed by small mammals (i.e., raccoons) and avian species (i.e., common snipe) feeding on small prey (e.g., *L. variegatus*) and foraging on plants from Janes Ravine, Hutchinson Ravine, and the Beach Area are presented in Tables 7-37 and 7-38. Benchmark values for some ecoCOPCs are not readily available in the literature for some of the animal species evaluated. However, for ecoCOPCs that have benchmark values, a calculated value is presented utilizing test endpoints for other phylogenetically similar species (i.e. within phylogenetic class). The chronic endpoint (original endpoint value) used for the benchmarks was a LOAEL or a NOAEL. Extrapolation among classes of organisms, although containing some inherent uncertainty, is a generally accepted practice (as described below). On the other hand, extrapolations between phylogenetic classes is more uncertain, and unlikely to be reliable. Extrapolations from mammalian benchmarks to avian benchmarks may underestimate toxicity when based solely on body weight (EPT, 1996). Benchmark values for some ecoCOPCs were not readily available in the literature for avian receptors. For estimation of avian oral toxicity for these ecoCOPCs, a regression technique was employed (Shortelle *et al.*, 1997).

The source for most of the benchmark calculations is the *Toxicological Benchmarks for Wildlife: 1996 Revision* (ES/ER/TM-86/R3). The Original Value (mg/kg/day) for the Test Organism (rat, mouse, dove, chicken, duck) was converted to an Endpoint Wildlife Value (mg/kg/day) for the species of concern (raccoon and Common Snipe) using the following equation:

$$\text{Endpoint Wildlife Value} = \text{Original Value} * (bw_t / bw_w)^{1/4}$$

where:  $bw_t$  = Test Organism body weight (kg)  
 $bw_w$  = Endpoint Species (Species of Concern) body weight (kg)

The Endpoint Wildlife Value for the species of concern was then converted into an ecoCOPC intake benchmark (mg/kg), representing the concentration of an ecoCOPC in either forage and prey that is a dose equivalent of the Endpoint Wildlife Value. Forage and prey intake benchmarks were calculated using the following equation:

$$\text{Food Intake Benchmark} = \text{Endpoint Wildlife Value (species of concern)} / f$$

where:  $f$  (food factor) =  $IR_f / bw_w$   
 $IR_f$  = site-specific food consumption rate (kg/day) for species of concern

The final benchmarks for ingestion of sediment ecoCOPCs via ingestion of forage and prey from species in Janes and Hutchinson Ravines, and the Beach Area are presented in Tables 7-37 and 7-38. These tables also present the factors for small mammals and avian species used in the above calculations and any constituent surrogates used to determine the benchmarks. As noted in the ecotoxicity discussion (Section 7.2.1), relevant and appropriate ecotoxicity benchmark values were not available for every ecoCOPC.



Table 7-1. Ecological Screening Benchmarks for Surface Water and Groundwater Constituents  
(Page 1 of 2)

Listcode	Chemname/Surrogate	Standard	Units	Type	Comments
246TNT	2,4,6-Trinitrotoluene	1.30E-01	mg/L	WQC	Chronic Water Quality Criteria
ACET	Acetone	1.12E+01	mg/L	Tier II	Secondary Chronic value
ANTRC	Anthracene	1.00E-04	mg/L	BTAG	Region 3 Value for Aquatic Fauna
SB	Antimony	1.60E+00	mg/L	AWQC	Chronic; LOEL
AS	Arsenic	1.90E-01	mg/L	AWQC	Total dissolved; Value for Arsenic III
BA	Barium	3.90E-03	mg/L	Tier II	Total dissolved
BAPYR	Benzo(a)pyrene	1.40E-05	mg/L	Tier II	
BKFANT	Benzo(k)fluoranthene/ Benzo(a)pyrene	1.40E-05	mg/L	Tier II	
BE	Beryllium	5.10E-03	mg/L	Tier II	Total dissolved
B2EHP	Bis(2-ethylhexyl) phthalate	3.20E-02	mg/L	Tier II	
B	Boron	5.47E-01	mg/L	Tier II	Secondary chronic value
BBZP	Butylbenzyl phthalate	1.90E-02	mg/L	Tier II	
CA	Calcium	1.16E+02	mg/L	LCV	Lowest chronic value - daphnids
CL	Chloride	1.20E+01	mg/L		Lake Michigan Water Quality Standard
CHCL3	Chloroform	1.24E+00	mg/L	AWQC	Chronic; LOEL
CH3CL	Chloromethane/ Chloroform	1.24E+00	mg/L	AWQC	Chronic; LOEL
CR3	Chromium III	8.26E-01	mg/L	AWQC	Total dissolved; hardness-dependent (based on site-specific hardness of 651 mg/L as CaCO <sub>3</sub> )
CR6	Chromium VI	1.00E-02	mg/L	AWQC	Total dissolved
CR	Chromium, total	7.42E-01	mg/L	AWQC	No value available; assumed chromium III
CO	Cobalt	3.00E-03	mg/L	Tier II	Total dissolved
CU	Copper	5.63E-02	mg/L	AWQC	Total dissolved; hardness-dependent (based on site-specific hardness of 651 mg/L as CaCO <sub>3</sub> )
CYN	Cyanide, total	5.20E-03	mg/L	AWQC	Total dissolved
PPDDD	DDD, p,p'-	1.00E-05	mg/L	Tier II	Secondary chronic value
PPDDE	DDE, p,p'-	1.05E+00	mg/L	AWQC	Acute; lowest observed effect level (LOEL)
PPDDT	DDT, p,p'-	1.30E-05	mg/L	Tier II	
CL10BP	Decachlorobiphenyl/ PCBs	1.90E-04	mg/L	Tier II	Ecotox, 1996
24DNT	Dinitrotoluene	2.30E-01	mg/L	AWQC	Chronic; LOEL for dinitrotoluene nonspecific
ENSLF*	Endosulfan, total	5.10E-05	mg/L	Tier II	
FANT	Fluoranthene	8.10E-03	mg/L	FCV	

Table 7-1. Ecological Screening Benchmarks for Surface Water and Groundwater Constituents  
(Page 2 of 2)

Listcode	Chemname/Surrogate	Standard	Units	Type	Comments
F	Fluoride	2.70E+00	mg/L	BTAG	Region 3 value for fauna
LIN	Hexachlorocyclohexane, gamma-(Lindane)	8.00E-05	mg/L	AWQC	
FE	Iron	1.00E+00	mg/L	AWQC	Total dissolved
PB	Lead	2.73E-02	mg/L	AWQC	Total dissolved; hardness-dependent (based on site-specific hardness of 651 mg/L as CaCO3)
MG	Magnesium	8.20E+01	mg/L	LCV	Lowest chronic value - daphnids
MN	Manganese	8.00E-02	mg/L	Tier II	Total dissolved
NI	Nickel	7.67E-01	mg/L	AWQC	Total dissolved; hardness-dependent (based on site-specific hardness of 651 mg/L as CaCO3)
PHANTR	Phenanthrene	6.30E-03	mg/L	FCV	
K	Potassium	5.30E+01	mg/L	LCV	Lowest chronic value - daphnids
PYR	Pyrene/Benzo(a)pyrene	1.40E-05	mg/L	Tier II	
NA	Sodium	6.80E+02	mg/L	LCV	Lowest chronic value - daphnids
SO4	Sulfate	2.40E+01	mg/L		Lake Michigan Water Quality Standard
CL4XYL	Tetrachloro-1,3-xylene,2,4,5,6-/Xylene	1.80E-03	mg/L	Tier II	Ecotox, 1996; EPA calculated value
TL	Thallium	4.00E-02	mg/L	AWQC	Chronic; LOEL
V	Vanadium	1.90E-02	mg/L	Tier II	Total dissolved
ZN	Zinc	5.11E-01	mg/L	AWQC	Total dissolved; hardness-dependent (based on site-specific hardness of 651 mg/L as CaCO3)

AWQC = Ambient Water Quality Criteria

BTAG = Biological Technical Assistance Group

FCV = final chronic value

LCV = lowest chronic value

LOEL = lowest observed effect level

mg/L = milligrams per liter

WQC = water quality criteria

Source: QST, 1998.

Table 7-2 Illinois Administrative Code (IAC) Screening Criteria for Surface Water and Groundwater Constituents (Page 1 of 2)

Analyte	Listcode	Chemname	Type	Standard	Units	Comments
Arsenic (total)	AS	Arsenic	Acute	3.60E-01	mg/L	IAC 35 Part 302 Subpart B
Arsenic (total)	AS	Arsenic	Chronic	1.90E-01	mg/L	IAC 35 Part 302 Subpart B
Arsenic (III)	AS3*	Arsenic III	Acute	3.60E-01	mg/L	IAC 35 Part 302 Subpart B; value for arsenic
Arsenic (III)	AS3*	Arsenic III	Chronic	1.90E-01	mg/L	IAC 35 Part 302 Subpart B; value for arsenic
Barium (total)	BA	Barium	Acute/Chronic	5.00E+00	mg/L	IAC 35 Part 302 Subpart B
Boron (total)	B	Boron	Acute/Chronic	1.00E+00	mg/L	IAC 35 Part 302 Subpart B
Cadmium (total)*	CD	Cadmium	Acute	8.06E-02	mg/L	IAC 35 Part 302 Subpart B; value adjusted for site-specific hardness of 651 mg/L (as CaCO <sub>3</sub> )
Cadmium (total)*	CD	Cadmium	Chronic	4.94E-03	mg/L	IAC 35 Part 302 Subpart B; value adjusted for site-specific hardness of 651 mg/L (as CaCO <sub>3</sub> )
Chloride (total)	CL	Chloride	Acute/Chronic	5.00E+02	mg/L	IAC 35 Part 302 Subpart B
TRC	CL2	Chlorine	Acute	1.90E-02	mg/L	IAC 35 Part 302 Subpart B
TRC	CL2	Chlorine	Chronic	1.10E-02	mg/L	IAC 35 Part 302 Subpart B
Chromium (total trivalent)*	CR3	Chromium III	Acute	8.05E+00	mg/L	IAC 35 Part 302 Subpart B; value adjusted for site-specific hardness of 651 mg/L (as CaCO <sub>3</sub> )
Chromium (total trivalent)*	CR3	Chromium III	Chronic	9.60E-01	mg/L	IAC 35 Part 302 Subpart B; value adjusted for site-specific hardness of 651 mg/L (as CaCO <sub>3</sub> )
Chromium (total hexavalent)	CR6	Chromium VI	Acute	1.60E-02	mg/L	IAC 35 Part 302 Subpart B
Chromium (total hexavalent)	CR6	Chromium VI	Chronic	1.10E-02	mg/L	IAC 35 Part 302 Subpart B
Chromium (total)	CR	Chromium, total	Acute	1.60E-02	mg/L	IAC 35 Part 302 Subpart B; value for chromium VI
Chromium (total)	CR	Chromium, total	Chronic	1.10E-02	mg/L	IAC 35 Part 302 Subpart B; value for chromium VI
Copper*	CU	Copper	Acute	1.04E-01	mg/L	IAC 35 Part 302 Subpart B; value adjusted for site-specific hardness of 651 mg/L (as CaCO <sub>3</sub> )
Copper*	CU	Copper	Chronic	5.86E-02	mg/L	IAC 35 Part 302 Subpart B; value adjusted for site-specific hardness of 651 mg/L (as CaCO <sub>3</sub> )
Cyanide	CYN	Cyanide, total	Acute	2.20E-02	mg/L	IAC 35 Part 302 Subpart B
Cyanide	CYN	Cyanide, total	Chronic	5.20E-03	mg/L	IAC 35 Part 302 Subpart B
Fluoride	F	Fluoride	Acute/Chronic	1.40E+00	mg/L	IAC 35 Part 302 Subpart B

Table 7-2 Illinois Administrative Code (IAC) Screening Criteria for Surface Water and Groundwater Constituents (Page 2 of 2)

Analyte	Listcode	Chemname	Type	Standard	Units	Comments
Iron (dissolved)	FE	Iron, dissolved	Acute/Chronic	1.00E+00	mg/L	IAC 35 Part 302 Subpart B
Lead (total)*	PB	Lead	Acute	8.86E-01	mg/L	IAC 35 Part 302 Subpart B; value adjusted for site-specific hardness of 651 mg/L (as CaCO3)
Manganese (total)	MN	Manganese	Acute/Chronic	1.00E+00	mg/L	IAC 35 Part 302 Subpart B
Mercury	HG	Mercury	Acute	5.00E-04	mg/L	IAC 35 Part 302 Subpart B
Nickel (total)	NI	Nickel	Acute/Chronic	1.00E+00	mg/L	IAC 35 Part 302 Subpart B
Selenium (total)	SE	Selenium	Acute/Chronic	1.00E+00	mg/L	IAC 35 Part 302 Subpart B
Silver (total)	AG	Silver	Acute/Chronic	5.00E-03	mg/L	IAC 35 Part 302 Subpart B
Sulfate	SO4	Sulfate	Acute/Chronic	5.00E+02	mg/L	IAC 35 Part 302 Subpart B
Zinc (total)	ZN	Zinc	Acute/Chronic	1.00E+00	mg/L	IAC 35 Part 302 Subpart B

7-30 mg/L = milligrams per liter.

Source: QST, 1998.

Table 7-3. AWQCs for Constituents Affected by Water Hardness

COPC	Slope (m)	y Intercept (B)	Conversion Factor	Units in mg/L*
Chromium (total trivalent)	8.19E-01	1.56E+00	8.60E-01	0.825572
Copper	8.55E-01	-1.47E+00	9.60E-01	0.056265
Lead	1.27E+00	-4.71E+00	7.91E-01	0.027322
Nickel	8.46E-01	1.16E+00	9.97E-01	0.766868
Zinc	8.47E-01	7.61E-01	9.86E-01	0.511088

Note: Water hardness of 651 mg/L used in calculations.

AWQC = Ambient Water Quality Criteria

mg/L = milligrams per liter

\* Calculation based upon criteria equation of  $\exp(m[\ln(\text{hardness})] + b) \times \text{conversion factor}$  obtained from Eco Update, 1996 (USEPA, 1996d).

Source: QST, 1998.

Table 7-4. IAC Criteria Adjusted for Site-Specific Water Hardness

COPC	Standard	Factor A	Factor B	Value in mg/L*
Cadmium	Acute	-2.92E+00	1.13E+00	8.06E-02
	Chronic	-3.49E+00	7.85E-01	4.94E-03
Chromium (total trivalent)	Acute	3.69E+00	8.19E-01	8.05E+00
	Chronic	1.56E+00	8.19E-01	9.60E-01
Copper	Acute	-1.46E+00	9.42E-01	1.04E-01
	Chronic	-1.47E+00	8.55E-01	5.86E-02
Lead	Acute	-1.46E+00	1.27E+00	8.86E-01
	Chronic			Not applied

Note: Water hardness of 651 mg/L used in calculations.

IAC = Illinois Administrative Code  
mg/L = milligrams per liter

\* Based upon calculation of  $\exp[\text{Factor A} + \text{Factor B}(\ln(\text{hardness}))]$  obtained from 35 IAC Subpart B Section 302.208.

Table 7-5. Ecological Screening Benchmarks for Constituents in Sediments (Page 1 of 3)

Listcode	Chemname/Surrogate	ET	Units	ETType	Comments
ANAPNE	Acenaphthene	6.20E-01	mg/kg	SQC	LCL95 (assumed TOC = 1%)
ANAPYL	Acenaphthylene	4.40E-02	mg/kg	ERL	Region III value for sediment flora and fauna
ALDRN	Aldrin	2.00E-03	mg/kg	OME Level II	lowest effect level (5% screening level concentration)
AL	Aluminum	1.00E+03	mg/kg	BTAG	Region III value for soil
ANTRC	Anthracene	8.53E-02	mg/kg	BTAG	
SB	Antimony	1.50E+02	mg/kg	BTAG	
AS	Arsenic	8.20E+00	mg/kg	ERL	value for all arsenic forms
BAANTR	Benzo(a)anthracene	2.61E-01	mg/kg	BTAG	
BAPYR	Benzo(a)pyrene	4.30E-01	mg/kg	ERL	
BBFANT	Benzo(b)fluoranthene	3.20E+00	mg/kg	BTAG	
BE	Beryllium	3.32E+00	mg/kg	SQC	Bodek <i>et al.</i> , 1988; calculated value using Tier II value
BGHPY	Benzo(g,h,i)perylene	6.70E-01	mg/kg	BTAG	
BKFANT	Benzo(k)fluoranthene	2.40E-01	mg/kg	OME LEL	Sediment Quality Guidance
B2EHP	Bis(2-ethylhexyl)phthalate	1.30E+00	mg/kg	BTAG	
BBZP	Butylbenzyl phthalate	1.10E+01	mg/kg	SQB	derived using equilibrium partitioning (assumed TOC = 1%)
CD	Cadmium	1.20E+00	mg/kg	ERL	
CLDAN	Chlordane, total	5.00E-03	mg/kg	OME NOEL	no effect level
ACLDAN	Chlordane, alpha-	5.00E-03	mg/kg	OME NOEL	no effect level for chlordane
GCILDAN	Chlordane, gamma-	5.00E-03	mg/kg	OME NOEL	no effect level for chlordane
CR	Chromium, total	8.10E+01	mg/kg	ERL	value for all chromium forms
CHRY	Chrysene	3.84E-01	mg/kg	BTAG	
CO	Cobalt	5.00E+01	mg/kg	OME Table 3	lowest effect level (Open Water Disposal Guidelines)
CU	Copper	3.40E+01	mg/kg	ERL	
CYN	Cyanide, total	1.00E-01	mg/kg	OME Table 3	lowest effect level (Open Water Disposal Guidelines)
PPDDD	DDD, p,p'-	8.00E-03	mg/kg	OME Level II	lowest effect level (5% screening level concentration)
PPDDE	DDE, p,p'-	5.00E-03	mg/kg	OME Level II	lowest effect level (5% screening level concentration)

7-33

Table 7-5. Ecological Screening Benchmarks for Constituents in Sediments (Page 2 of 3)

Listcode	Chemname/Surrogate	ET	Units	ETType	Comments
PPDDT	DDT, p,p'-	8.00E-03	mg/kg	OME Level II	lowest effect level (5% screening level concentration)
DBAHA	Dibenzo(a,h)anthracene	6.34E-02	mg/kg	BTAG	
DBZFUR	Dibenzofuran	2.00E+00	mg/kg	SQB	derived using equilibrium partitioning (assumed TOC = 1%)
ENDRN	Endrin	2.00E-02	mg/kg	SQC	LCL95 (assumed TOC = 1%)
FANT	Fluoranthene	2.90E+00	mg/kg	SQC	LCL95 (assumed TOC = 1%)
FLRENE	Fluorene	5.40E-01	mg/kg	SQB	derived using equilibrium partitioning (assumed TOC = 1%)
LIN	Hexachlorocyclohexane, gamma-(Lindane)	3.00E-03	mg/kg	OME Level II	lowest effect level (10% screening level concentration)
ICDPYR	Indeno(1,2,3-cd)pyrene	6.00E-01	mg/kg	BTAG	
FE	Iron	2.00E+04	mg/kg	OME Level II	lowest effect level (5% screening level concentration)
PB	Lead	4.70E+01	mg/kg	ERL	
MN	Manganese	4.60E+02	mg/kg	OME Level II	lowest effect level (5% screening level concentration)
HG	Mercury	1.50E-01	mg/kg	ERL	value for all mercury forms
MEXCLR	Methoxychlor	1.90E-02	mg/kg	SQB	derived using equilibrium partitioning (assumed TOC = 1%)
1MNAP	Methylnaphthalene, 1-	1.35E+02	mg/kg	Suter <i>et al.</i> , 1996	secondary chronic value
2MNAP	Methylnaphthalene, 2-	3.30E-01	mg/kg	Reg 4	sediment screening value
NAP	Naphthalene	4.80E-01	mg/kg	SQB	derived using equilibrium partitioning (assumed TOC = 1%)
NI	Nickel	2.10E+01	mg/kg	ERL	
PHANTR	Phenanthrene	8.50E-01	mg/kg	SQC	LCL95 (assumed TOC = 1%)
PYR	Pyrene	6.60E-01	mg/kg	ERL	
SE	Selenium	1.80E+03	mg/kg	BTAG	Region III value for soil
AG	Silver	5.00E-01	mg/kg	OME Table 3	lowest effect level (Open Water Disposal Guidelines)
CCL3F	Trichlorofluoromethane	6.76E+01	mg/kg	SQC	Ecotox Update, 1996; calculated value using AWQC
V	Vanadium	5.00E+02	mg/kg	BTAG	Region III value for soil



Table 7-5. Ecological Screening Benchmarks for Constituents in Sediments (Page 3 of 3)

Listcode	Chemname/Surrogate	ET	Units	ETType	Comments
ZN	Zinc	1.50E+02	mg/kg	ERL	
13DNB	Dinitrobenzene, 1,3-	4.00E-02	mg/kg	SQB	Talmage and Opresko, 1995
TRPHEN	Triphenylene/Pyrene	6.60E-01	mg/kg	ERL	NOAA

ERL = effects range low

ET = ecotoxicity threshold

LEL = lowest effect level

NOAA = National Oceanic and Atmospheric Administration

NOEL = no observed effect level

OME = Ontario Ministry of the Environment

SQB = sediment quality benchmark

SQC = sediment quality criteria

Table 7-6. Ecological Risk-Based Screening of Constituents in Janes Ravine Sediments

Constituent	Maximum Concentration Detected in Sediment (mg/kg)	Ecological Benchmark (mg/kg)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Acenaphthene	1.60E-01	6.20E-01	No
Anthracene	5.37E-02	8.53E-02	No
Antimony	9.23E+00	1.50E+02	No
Benzo(a)pyrene	3.20E-02	4.30E-01	No
Benzo(b)fluoranthene	4.60E-02	3.20E+00	No
Benzo(g,h,i)perylene	2.03E-02	6.70E-01	No
Benzo(k)fluoranthene	1.70E-01	2.40E-01	No
Bis(2-ethylhexyl) phthalate	5.20E-01	1.30E+00	No
Chlordane, total	5.20E+00	5.00E-03	Yes
Chrysene	3.30E-01	3.84E-01	No
DDD, p,p'-	6.60E+00	8.00E-03	Yes
DDE, p,p'-	4.80E-01	5.00E-03	Yes
DDT, p,p'-	5.90E+00	8.00E-03	Yes
Dibenzo(a,h)anthracene	6.24E-03	6.34E-02	No
Fluoranthene	4.40E-01	2.90E+00	No
Hexachlorocyclohexane, gamma- (Lindane)	7.10E-02	3.00E-03	Yes
Methoxychlor	1.06E-01	1.90E-02	Yes
Methylnaphthalene, 2-	3.70E-01	3.30E-01	Yes
Naphthalene	1.72E-01	4.80E-01	No
Phenanthrene	3.01E-01	8.50E-01	No
Pyrene	5.30E-01	6.60E-01	No
Silver	6.30E-01	5.00E-01	Yes

mg/kg = milligrams per kilogram

Source: QST, 1998.

Table 7-7. Ecological Risk-Based Screening of Constituents in Hutchinson Ravine Sediments  
(Page 1 of 2)

Constituent	Maximum Concentration Detected in Sediment (mg/kg)	Ecological Benchmark (mg/kg)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
2,4,5-T	2.72E-02	--	NE
Acenaphthene	2.45E+00	6.20E-01	Yes
Acenaphthylene	1.73E+00	4.40E-02	Yes
Aldrin	2.53E-02	2.00E-03	Yes
Anthracene	7.00E+00	8.53E-02	Yes
Antimony	7.88E+00	1.50E+02	No
Benzo(a)anthracene	1.00E+01	2.61E-01	Yes
Benzo(a)pyrene	8.00E+00	4.30E-01	Yes
Benzo(b)fluoranthene	8.00E+00	3.20E+00	Yes
Benzo(g,h,i)perylene	4.00E+00	6.70E-01	Yes
Benzo(k)fluoranthene	5.00E+00	2.40E-01	Yes
Bis(2-ethylhexyl) phthalate	2.15E-01	1.30+00	No
Cadmium	5.37E-01	1.20E+00	No
Carbazole	2.00E+00	--	NE
Chlordane, alpha-	8.60E-02	5.00E-03	Yes
Chlordane, gamma-	9.44E-02	5.00E-03	Yes
Chlordane, total	9.30E-01	5.00E-03	Yes
Chrysene	1.00E+01	3.84E-01	Yes
Cyanide, total	7.83E-01	1.00E-01	Yes
DDD, p,p'-	1.00E+01	8.00E-03	Yes
DDE, p,p'-	5.90E-01	5.00E-03	Yes
DDT, p,p'-	9.30E-01	8.00E-03	Yes
Dibenzo(a,h)anthracene	6.00E-01	6.34E-02	Yes
Dibenzofuran	2.00E+00	2.00E+00	No

Table 7-7. Ecological Risk-Based Screening of Constituents in Hutchinson Ravine Sediments  
(Page 2 of 2)

Constituent	Maximum Concentration Detected in Sediment (mg/kg)	Ecological Benchmark (mg/kg)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Endrin	2.03E-02	2.00E-02	Yes
Fluoranthene	3.00E+01	2.90E+00	Yes
Fluorene	4.00E+00	5.40E-01	Yes
Hexachlorocyclohexane, gamma- (Lindane)	6.28E-03	3.00E-03	Yes
Indeno(1,2,3-cd)pyrene	4.00E+00	6.00E-01	Yes
Mercury	2.20E-01	1.50E-01	Yes
Methylnaphthalene, 1-	2.89E+00	1.35E+02	No
Methylnaphthalene, 2-	3.70E+00	3.30E-01	Yes
Naphthalene	2.31E+00	4.80E-01	Yes
Phenanthrene	3.00E+01	8.50E-01	Yes
Pyrene	2.00E+01	6.60E-01	Yes
Selenium	2.71E-01	1.80E+03	No
Silver	1.05E+00	5.00E-01	Yes
Trichlorofluoromethane	1.20E-02	6.76E+01	No

mg/kg = milligrams per kilogram

NE = not evaluated due to lack of benchmark data

Source: QST, 1998.

Table 7-8 Ecological Risk-Based Screening of Constituents in Beach Area Sediments (Page 1 of 2)

Constituent	Maximum Concentration Detected in Sediment (mg/kg)	Ecological Benchmark (mg/kg)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Acenaphthene	2.39E-01	6.20E-01	No
Aluminum	6.40E+03	1.00E+03	Yes
Antimony	6.90E+0	1.50E+02	No
Arsenic	1.31E+01	8.20E+00	Yes
Benzo(a)anthracene	6.11E-03	2.61E-01	No
Benzo(a)pyrene	7.21E-03	4.30E-01	No
Benzo(b)fluoranthene	8.01E-03	3.20E+00	No
Benzo(g,h,i)perylene	9.31E-03	6.70E-01	No
Benzo(k)fluoranthene	4.14E-03	2.40E-01	No
Calcium	9.10E+04	--	NE
Chlordane, total	1.18E-01	5.00E-03	Yes
Chromium, total	4.68E+00	8.10E+01	No
Cobalt	3.51E+00	5.00E+01	No
Copper	8.06E+00	3.40E+01	No
DDD, p,p'-	4.30E-01	8.00E-03	Yes
DDE, p,p'-	3.50E-02	5.00E-03	Yes
DDT, p,p'-	9.80E-02	8.00E-03	Yes
Fluoranthene	1.65E-02	2.90E+00	No
Hexachlorocyclohexane, gamma- (Lindane)	1.99E-02	3.00E-03	Yes
Indeno(1,2,3-cd)pyrene	4.60E-03	6.00E-01	No
Iron	1.30E+04	2.00E+04	No
Lead	1.46E+01	4.70E+01	No
Magnesium	4.60E+04	--	NE
Manganese	6.27E+02	4.60E+02	Yes

Table 7-8 Ecological Risk-Based Screening of Constituents in Beach Area Sediments (Page 2 of 2)

Constituent	Maximum Concentration Detected in Sediment (mg/kg)	Ecological Benchmark (mg/kg)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Methylnaphthalene, 2-	1.43E-01	3.30E-01	No
Nickel	2.78E+01	2.10E+01	Yes
Phenanthrene	5.30E-02	8.50E-01	No
Potassium	2.01E+03	--	NE
Pyrene	2.76E-02	6.60E-01	No
Sodium	5.13E+02	--	NE
Trichlorofluoromethane	1.00E-02	6.76E+01	No
Vanadium	5.90E+01	5.00E+02	No
Zinc	1.40E+02	1.50E+02	No

mg/kg = milligram per kilogram

NE = not evaluated due to lack of benchmark data

Source: QST, 1998.

Table 7-9. Ecological Risk-Based Screening of Constituents in Lake Michigan Sediments

Constituent	Maximum Concentration Detected in Sediment (mg/kg)	Ecological Benchmark (mg/kg)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Aluminum	1.45E+03	1.00E+03	Yes
Arsenic	3.04E+00	8.20E+00	No
Benzo(a)anthracene	2.87E-03	2.61E-01	No
Benzo(a)pyrene	2.76E-03	4.30E-01	No
Benzo(b)fluoranthene	3.56E-03	3.20E+00	No
Benzo(k)fluoranthene	1.51E-03	2.40E-01	No
Beryllium	3.41E-01	3.32E+00	No
Calcium	5.47E+04	--	NE
Chromium, total	4.63E+00	8.10E+01	No
Chrysene	1.36E-02	3.84E-01	No
Copper	7.37E+00	3.40E+01	No
Dinitrobenzene, 1,3-	2.97E-01	4.00E-02	Yes
Fluoranthene	8.94E-03	2.90E+00	No
Indeno(1,2,3-cd)pyrene	3.92E-03	6.00E-01	No
Iron	6.85E+03	2.00E+04	No
Lead	5.46E+00	4.70E+01	No
Magnesium	3.19E+04	--	NE
Manganese	3.60E+02	4.60E+02	No
Nickel	4.89E+00	2.10E+01	No
Potassium	3.07E+02	--	NE
Pyrene	8.58E-03	6.60E-01	No
Sodium	3.82E+02	--	NE
Triphenylene	2.92E-01	6.60E-01	No
Vanadium	1.34E+01	5.00E+02	No
Zinc	3.81E+01	1.50E+02	No

-- = No benchmark data available.

mg/kg = milligram per kilogram

NE = Not evaluated due to lack of benchmark data.

Source: QST, 1998.

Table 7-10. Ecological Risk-Based Screening of Constituents in Janes Ravine Surface Water

Constituent	Maximum Concentration Detected in Surface Water (mg/L)	Ecological Benchmark (mg/L)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Boron	1.49E-01	5.47E-01	No
Butylbenzyl phthalate	2.10E-03	1.90E-02	No
Chloride	4.80E+02	1.20E+01	Yes
Copper	9.31E-03	5.63E-02	No
DDD, p,p'-	2.20E-05	1.00E-05	Yes
DDT, p,p'-	1.10E-05	1.30E-05	No
Hexachlorocyclohexane, gamma- (Lindane)	1.10E-05	8.00E-05	No
Lead	6.50E-03	2.73E-02	No
Manganese	2.21E-01	8.00E-02	Yes
Nitrogen, NO <sub>2</sub> + NO <sub>3</sub>	6.60E-01	--	NE
Sulfate	1.70E+02	2.40E+01	No
Vanadium	1.13E-02	1.90E-02	No
Zinc	5.00E-02	5.11E-01	No

-- = No benchmark data available.

mg/L = milligram per liter

NE = Not evaluated due to lack of benchmark data.

Source: QST, 1998.



Table 7-11. Ecological Risk-Based Screening of Constituents in Hutchinson Ravine Surface Water

Constituent	Maximum Concentration Detected in Surface Water (mg/L)	Ecological Benchmark (mg/L)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Anthracene	9.47E-04	1.00E-04	Yes
Benzo(a)pyrene	1.47E-05	1.40E-05	Yes
Benzo(b)fluoranthene	8.80E-06	1.40E-05	No
Bis(2-ethylhexyl) phthalate	1.40E-02	3.20E-02	No
Boron	1.70E-01	5.47E-01	No
Butylbenzyl phthalate	3.00E-03	1.90E-02	No
Calcium	1.51E+02	1.15E+02	Yes
Chloride	1.00E+03	1.20E+01	Yes
Chloromethane	1.20E-02	1.24E+00	No
Cyanide, total	5.33E-03	5.20E-03	Yes
DDD, p,p'-	1.10E-04	1.00E-05	Yes
DDE, p,p'-	1.20E-05	1.05E+00	No
DDT, p,p'-	2.00E-05	1.30E-05	Yes
Decachlorobiphenyl	3.30E-04	1.90E-04	Yes
Fluoranthene	1.02E-04	8.10E-03	No
Fluoride	5.40E-01	2.70E+00	No
Hexachlorocyclohexane, gamma- (Lindane)	1.05E-05	8.00E-05	No
Lead	7.70E-03	2.73E-02	No
Manganese	1.81E+00	8.00E-02	Yes
Nitrogen, NO <sub>2</sub> +NO <sub>3</sub>	9.20E-01	--	NE
Pyrene	2.80E-04	1.40E-05	Yes
Sodium	5.40E+02	6.80E+02	No
Sulfate	2.00E+02	2.40E+01	Yes
Tetrachloro-1,3-xylene, 2,4,5,6-	7.77E-04	1.80E-03	No
Zinc	7.32E-02	5.11E-01	No

-- = No benchmark data available.

mg/L = milligram per liter

NE = Not evaluated due to lack of benchmark data.

Source: QST, 1998.

Table 7-12. Ecological Risk-Based Screening of Constituents in Beach Area Surface Water

Constituent	Maximum Concentration Detected in Surface Water (mg/L)	Ecological Benchmark (mg/L)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Barium	4.20E-02	3.90E-03	Yes
Calcium	1.30E+02	1.16E+02	Yes
Chloride	1.20E+02	1.20E+01	Yes
Chloroform	1.60E-03	1.24E3+00	No
Iron	9.66E-02	1.00E+00	No
Lead	3.04E-03	2.73E-02	No
Magnesium	5.30E+01	8.20E+01	No
Manganese	2.83E-01	8.00E-02	Yes
Nitrogen, NO <sub>2</sub> +NO <sub>3</sub>	7.80E-01	--	NE
Potassium	4.04E+00	5.30E+01	No
Sodium	5.03E+01	6.80E+02	No
Sulfate	2.69E+02	2.40E+01	Yes

-- = No benchmark data available.

mg/L = milligram per liter

NE = Not evaluated due to lack of benchmark data.

Source: QST, 1998.

Table 7-13. Ecological Risk-Based Screening of Constituents in Beach Area Groundwater

Study Area	Constituent	Maximum Concentration Detected in Groundwater mg/L	Ecological Benchmarks mg/L	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Beach	Acetone	3.20E-02	1.12E+01	No
	Amino-2,6-dinitrotoluene, 4-	1.77E-04	--	NE
	Anthracene	6.60E-04	1.00E-04	Yes
	Antimony	5.30E-02	1.60E+00	No
	Arsenic	4.15E-02	1.90E-01	No
	Barium	1.03E+00	3.90E-03	Yes
	Benzo(a)anthracene	3.03E-05	--	NE
	Benzo(a)pyrene	5.42E-05	1.40E-05	Yes
	Benzo(g,h,i)perylene	1.10E-04	--	NE
	Benzo(k)fluoranthene	2.13E-05	--	NE
	Beryllium	1.75E-02	5.10E-03	Yes
	Bis(2-ethylhexyl) phthalate	2.70E-03	3.20E-02	No
	Calcium	5.88E+02	1.16E+02	Yes
	Chromium, total	2.66E-01	7.42E-01	No
	Cobalt	1.08E-01	3.00E-03	Yes
	Copper	2.38E-01	5.63E-02	Yes
	DDD, p,p'-	2.40E-05	1.00E-05	Yes
	DDT, p,p'-	2.50E-05	1.30E-05	Yes
	Dinitrotoluene	2.68E-04	2.30E-01	No
	Endosulfan sulfate	8.20E-05	5.10E-05	Yes
	Fluoranthene	5.07E-05	8.10E-03	No
	Hexachlorocyclohexane, alpha-	5.30E-06	--	NE
	Indeno(1,2,3-cd)pyrene	1.39E-04	--	NE
	Iron	2.07E+02	1.00E+00	Yes
	Lead	9.50E-02	2.73E-02	Yes
	Manganese	4.05E+00	8.00E-02	Yes
	Mercury	3.62E-04	1.30E-03	No
	Methylnaphthalene, 2-	3.80E-03	--	NE
	Nickel	2.65E-01	7.67E-01	No
	Phenanthrene	7.62E-04	6.30E-03	No
	Pyrene	1.33E-04	1.40E-05	Yes
	Thallium	3.90E-03	4.00E-02	No
	Trinitrotoluene, 2,4,6-	1.31E-03	1.30E-01	No
	Vanadium	3.36E-01	1.90E-02	Yes
	Zinc	4.54E-01	5.11E-01	No

-- = No benchmark data available.

mg/L = milligrams per liter

NE = not evaluated due to lack of benchmark data.

Source: QST, 1998.

Table 7-14. Ecological Risk-Based Screening Using IAC Criteria in Surface Water and Groundwater (Page 1 of 5)

Study Area	Constituent	Maximum Concentration Detected in Surface Water (mg/L)	IAC Benchmark (mg/L)	Benchmark Type (Acute or Chronic)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Beach Area	Acetone	3.20E-02	-	-	NE
	Amino-2,6-dinitrotoluene, 4-	1.77E-04	-	-	NE
	Anthracene	6.60E-04	-	-	NE
	Antimony	5.30E-02	-	-	NE
	Arsenic	4.15E-02	3.60E-01	Acute	NO
	Arsenic	4.15E-02	1.90E-01	Chronic	NO
	Barium	1.03E+00	5.00E+00	Acute/Chronic	NO
	Benzo(a)anthracene	3.03E-05	-	-	NE
	Benzo(a)pyrene	5.42E-05	-	-	NE
	Benzo(g,h,i)perylene	1.10E-04	-	-	NE
	Benzo(k)fluoranthene	2.13E-05	-	-	NE
	Beryllium	1.75E-02	-	-	NE
	Bis(2-ethylhexyl) phthalate	2.70E-03	-	-	NE
	Calcium	5.88E+02	-	-	NE
	Chromium, total	2.66E-01	8.05E+00	Acute	NO
	Chromium, total	2.66E-01	9.60E-01	Chronic	NO
	Cobalt	1.08E-01	-	-	NE
	Copper	2.38E-01	1.04E-01	Acute	YES
	Copper	2.38E-01	5.86E-02	Chronic	YES

Table 7-14. Ecological Risk-Based Screening Using IAC Criteria in Surface Water and Groundwater (Page 2 of 5)

Study Area	Constituent	Maximum Concentration Detected in Surface Water (mg/L)	IAC Benchmark (mg/L)	Benchmark Type (Acute or Chronic)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
	DDD, p,p'-	2.40E-05	-	-	NE
	DDT, p,p'-	2.50E-05	-	-	NE
	Dinitrotoluene, 2,4-	2.68E-04	-	-	NE
	Endosulfan sulfate	8.20E-05	-	-	NE
	Fluoranthene	5.07E-05	-	-	NE
	Hexachlorocyclohexane, alpha-	5.30E-06	-	-	NE
	Indeno(1,2,3-cd)pyrene	1.39E-04	-	-	NE
	Iron	2.07E+02	1.00E+00	Acute/Chronic	YES
	Lead	9.50E-02	8.86E-01	Acute	NO
	Manganese	4.05E+00	1.00E+00	Acute/Chronic	YES
	Mercury	3.62E-04	5.00E-04	Acute	NO
	Mercury	3.62E-04	5.00E-04	Chronic	NO
	Methylnaphthalene, 2-	3.80E-03	-	-	NE
	Nickel	2.65E-01	1.00E+00	Acute/Chronic	NO
	Phenanthrene	7.62E-04	-	-	NE
	Pyrene	1.33E-04	-	-	NE
	Thallium	3.90E-03	-	-	NE
	Trinitrotoluene, 2,4,6-	1.31E-03	-	-	NE
	Vanadium	3.36E-01	-	-	NE

Table 7-14. Ecological Risk-Based Screening Using IAC Criteria in Surface Water and Groundwater (Page 3 of 5)

Study Area	Constituent	Maximum Concentration Detected in Surface Water (mg/L)	IAC Benchmark (mg/L)	Benchmark Type (Acute or Chronic)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
	Zinc	4.54E-01	1.00E+00	Acute/Chronic	NO
Janes Ravine	Aluminum	5.40E+00	—	—	NE
	Arsenic	2.70E-03	3.60E-01	Acute	NO
	Arsenic	2.70E-03	1.90E-01	Chronic	NO
	Barium	8.23E-02	5.00E+00	Acute/Chronic	NO
	Boron	1.49E-01	1.00E+00	Acute/Chronic	NO
	Butylbenzyl phthalate	2.10E-03	—	—	NE
	Calcium	1.11E+02	—	—	NE
	Copper	9.31E-03	1.04E-01	Acute	NO
	Copper	9.31E-03	5.86E-02	Chronic	NO
	DDT, p,p'-	1.10E-05	—	—	NE
	Hexachlorocyclohexane, gamma- (Lindane)	1.10E-05	—	—	NE
	Iron	4.90E+00	1.00E+00	Acute/Chronic	YES
	Lead	6.50E-03	8.86E-01	Acute	NO
	Magnesium	7.20E+01	—	—	NE
	Potassium	5.48E+00	—	—	NE

Table 7-14. Ecological Risk-Based Screening Using IAC Criteria in Surface Water and Groundwater (Page 4 of 5)

Study Area	Constituent	Maximum Concentration Detected in Surface Water (mg/L)	IAC Benchmark (mg/L)	Benchmark Type (Acute or Chronic)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Hutchinson Ravine	Sodium	2.27E+02	--	--	NE
	Vanadium	1.13E-02	--	--	NE
	Zinc	5.00E-02	1.00E+00	Acute/Chronic	NO
	Aluminum	2.36E+00	--	--	NE
	Arsenic	2.70E-03	3.60E-01	Acute	NO
	Arsenic	2.70E-03	1.90E-01	Chronic	NO
	Barium	1.08E-01	5.00E+00	Acute/Chronic	NO
	Benzo(k)fluoranthene	8.80E-06	--	--	NE
	Bis(2-ethylhexyl)phthalate	1.40E-02	--	--	NE
	Boron	1.70E-01	1.00E+00	Acute/Chronic	NO
	Butylbenzyl phthalate	3.00E-03	--	--	NE
	Chloromethane	1.20E-02	--	--	NE
	DDE, p,p'	1.20E-05	--	--	NE
	Fluoranthene	1.02E-04	--	--	NE
	Fluoride	5.40E-01	1.40E+00	Acute/Chronic	NO
	Hexachlorocyclohexane, gamma- (Lindane)	1.05E-05	--	--	NE
	Iron	7.14E+00	1.00E+00	Acute/Chronic	YES

Table 7-14. Ecological Risk-Based Screening Using IAC Criteria in Surface Water and Groundwater (Page 5 of 5)

Study Area	Constituent	Maximum Concentration Detected in Surface Water (mg/L)	IAC Benchmark (mg/L)	Benchmark Type (Acute or Chronic)	Does Maximum Detected Concentration Exceed Benchmark Concentration?
Beach Area	Lead	7.70E-03	8.86E-01	Acute	NO
	Magnesium	7.27E+01	--	--	NE
	Potassium	8.86E+00	--	--	NE
	Sodium	5.40E+02	--	--	NE
	Tetrachloro-1,3-xylene, 2,4,5,6-	7.77E-04	--	--	NE
	Zinc	7.32E-02	1.00E+00	Acute/Chronic	NO
	Chloroform	1.60E-03	--	--	NE
	Iron	9.66E-02	1.00E+00	Acute/Chronic	NO
	Lead	3.04E-03	8.86E-01	Acute	NO
	Magnesium	5.30E+01	--	--	NE
	Potassium	4.04E+00	--	--	NE
	Sodium	5.09E+01	--	--	NE

-- = No benchmark data available.

IAC = Illinois Administrative Code

mg/L = milligrams per liter

NE = Not evaluated due to no benchmark data.

Source: QST, 1998.



Table 7-15. Ecological Constituents of Potential Concern for Janes Ravine

Medium	Ecological Constituent of Potential Concern
Surface Water	DDD, p,p'- DDT, p,p'- Manganese Sulfate
Sediment	Chlordane, total DDD, p,p'- DDE, p,p'- DDT, p,p'- Hexachlorocyclohexane, gamma- (Lindane) Methoxychlor Methylnaphthalene, 2- Silver

Source: QST, 1998.

Table 7-16. Ecological Constituents of Potential Concern for Hutchinson Ravine

Medium	Ecological Constituent of Potential Concern
Surface Water	Anthracene Benzo(a)pyrene Cyanide DDD, p,p'- DDE, p,p'- DDT, p,p'- Decachlorobiphenyl Manganese Pyrene Sulfate
Sediment	2,4,5-T Acenaphthene Acenaphthylene Aldrin Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(g,h,i)perylene Benzo(k)fluoranthene Cadmium Carbazole Chlordane, alpha- Chlordane, gamma- Chlordane, total Chrysene Cyanide, total DDD, p,p'- DDE, p,p'- DDT, p,p'- Dibenzo(a,h)anthracene Endrin Fluoranthene Fluorene Hexachlorocyclohexane, gamma- (Lindane) Indeno(1,2,3-cd)pyrene Mercury Methyl-naphthalene, 2- Naphthalene Phenanthrene Pyrene Silver

Source: QST, 1998.

Table 7-17. Ecological Constituents of Potential Concern for the Beach Area (Including Lake Michigan Sediment)

Medium	Ecological Constituent of Potential Concern	
Beach Area		
Groundwater	Amino-2,6-dinitrotoluene, 4-	
	Barium	Endosulfan sulfate
	Benzo(a)anthracene	Indeno(1,2,3-cd)pyrene
	Benzo(a)pyrene	Lead
	Benzo(g,h,i)perylene	Manganese
	Benzo(k)fluoranthene	Mercury
	Cobalt	Methylnaphthalene, 2-
	Copper	Pyrene
	DDD, p,p'-	Vanadium
	DDT, p,p'-	Zinc
	Sediment	Aluminum
Antimony		
Arsenic		
Chlordane		
DDD, p,p'-		
DDE, p,p'-		
DDT, p,p'-		
Hexachlorocyclohexane, gamma (Lindane)		
Manganese		
Nickel		
Zinc		
Surface Water	Barium	
	Manganese	
	Sulfate	
Lake Michigan		
Sediment	Aluminum	
	Dinitrobenzene, 1,3-	

Source: QST, 1998.

Table 7-18. Physicochemical Properties for the Organic COPCs (Page 1 of 2)

Organic EcoCOPC	Molecular Weight (g/mol)	Water Solubility (mg/L @ 25°C)	Vapor Pressure (mmHg @ 25°C)	H (atm-m <sup>3</sup> /mol @ 25°C)	K <sub>ow</sub> (L/kg)	log K <sub>ow</sub> (L/kg)
2,4,5-T	255	2.68E+0-2 (a)	5.25E-09 (g)	6.35E-12 (b)	5.20E+01 (f)	2.85 (b)
Acenaphthene	154	4.24E+00 (b)	5.00E-03 (g)	1.55E-04 (b)	4.90E+03 (b)	3.92 (b)
Acenaphthylene	152	3.93E+00 (a)	2.30E-02 (g)	1.14E-03 (b)	4.79E+03 (f)	4.07 (b)
Aldrin	365	1.80E-01 (b)	6.00E-06 (g)	1.70E-04 (b)	4.87E+04 (b)	6.50 (b)
Amino-2,6-dinitrotoluene, 4-	197	1.80E+03 (c)	2.00E-05 (c)	1.00E-03 (c)	NA	0.60 (c)
Anthracene	178	4.34E-02 (b)	1.30E-06 (g)	6.50E-05 (b)	2.35E+04 (b)	4.55 (b)
Benzo(a)anthracene	228	9.40E-03 (b)	1.50E-07 (g)	3.35E-06 (b)	3.58E+05 (b)	5.70 (b)
Benzo(a)pyrene	252	1.62E-03 (b)	5.67E-04 (g)	1.13E-06 (b)	9.69E+05 (b)	6.11 (b)
Benzo(b)fluoranthene	252	1.50E-03 (b)	5.00E-07 (a)	1.11E-04 (h)	1.23E+06 (b)	6.20 (b)
Benzo(g,h,i)perylene	276	2.60E-04 (a)	1.00E-010 (a)	1.44E-07 (b)	7.76E+06 (f)	6.58 (a)
Benzo(k)fluoranthene	252	8.00E-04 (b)	9.59E-011 (g)	8.29E-07 (b)	1.23E+06 (b)	6.20 (b)
Carbazole	167	7.48E+00 (b)	1.37E-06 (a)	1.53E-08 (b)	3.39E+03 (b)	3.59 (b)
Chlordane, alpha	410	5.60E-02 (b,d)	1.00E-05 (d,g)	4.86E-05 (b,d)	5.13E+04 (b,d)	6.32 (b,d)
Chlordane, gamma-	410	5.60E-02 (b,d)	1.00E-05 (d,g)	4.86E-05 (b,d)	5.13E+04 (b,d)	6.32 (b,d)
Chlordane, total	410	5.60E-02 (b)	1.00E-05 (g)	4.86E-05 (b)	5.13E+04 (b)	6.32 (b)
Chrysene	228	1.60E-03 (b)	5.76E-01 (g)	9.46E-05 (b)	3.98E+05 (b)	5.70 (b)
DDD, p,p'-	320	9.00E-02 (b)	1.02E-06 (a)	4.00E-06 (b)	4.58E+04 (b)	6.10 (b)
DDE, p,p'-	318	1.20E-01 (b)	6.50E-06 (g)	2.10E-05 (b)	8.64E+04 (b)	6.76 (b)
DDT, p,p'-	354	2.50E-02 (b)	1.50E-07 (g)	8.10E-06 (b)	6.78E+05 (b)	6.53 (b)
Decachlorobiphenyl	0	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	278	2.49E-03 (b)	1.00E-10 (a)	1.47E-08 (b)	1.79E+06 (b)	6.69 (b)
Dinitrobenzene, 1,3-	168	5.33E+02 (e)	1.31E-04 (e)	5.44E-08 (e)	3.60E+01 (e)	1.49 (e)
Endosulfan sulfate	423	1.17E-01 (a)	1.00E-05 (a)	2.00E-05 (f)	2.34E+03 (f)	3.66 (a)
Endrin	381	2.50E-01 (b)	2.00E-07 (g)	7.52E-06 (b)	1.08E+04 (b)	5.06 (b)

Table 7-18. Physicochemical Properties for the Organic COPCs (Page 2 of 2)

Organic EcoCOPC	Molecular Weight (g/mol)	Water Solubility (mg/L @ 25°C)	Vapor Pressure (mmHg @ 25°C)	H (atm-m <sup>3</sup> /mol @ 25°C)	K <sub>oc</sub> (L/kg)	log K <sub>ow</sub> (L/kg)
Fluoranthene	202	2.06E-01 (b)	1.77E-02 (g)	1.61E-05 (b)	4.91E+04 (b)	5.12 (b)
Fluorene	166	1.98E+00 (b)	3.20E-04 (a)	6.36E-05 (b)	7.71E+03 (b)	4.21 (b)
Hexachlorocyclohexane, gamma-(Lindane)	291	6.80E+00 (b)	1.09E-05 (g)	1.40E-05 (b)	1.35E+03 (b)	3.73 (b)
Indeno(1,2,3-cd)pyrene	276	2.20E-05 (b)	1.00E-09 (g)	1.60E-06 (b)	3.47E+06 (b)	6.65 (b)
Methoxychlor	346	4.50E-02 (b)	1.55E-04 (g)	1.58E-05 (b)	8.00E+04 (b)	5.08 (b)
Methylnaphthalene, 2-	142	2.60E+01 (f)	6.77E-02 (g)	5.80E-05 (g)	2.45E+03 (i)	3.86 (a)
Naphthalene	128	3.10E+01 (b)	2.30E-01 (g)	4.83E-04 (b)	1.19E+03 (b)	3.36 (b)
Phenanthrene	178	8.16E-01 (f)	9.60E-04 (h)	2.50E-05 (h)	1.41E+04 (h)	4.46 (f)
Pyrene	202	1.35E-01 (b)	6.85E-07 (a)	1.10E-05 (b)	6.80E+04 (b)	5.11 (b)

atm-m<sup>3</sup>/mol = atmosphere meters cubed per mole

COPC = constituent of potential concern

°C = degrees Celsius

g/mol = grams per mole

H = Henry's Law constant

K<sub>oc</sub> = organic carbon partition coefficientK<sub>ow</sub> = octanol-water partition coefficient

L/kg = liters per kilogram

mg/L = milligrams per liter

mm Hg = millimeters of mercury

NA = not located in available literature

(a) HSDB, TOMES CD/ROM, Vol. 33; expires 7/31/97.

(b) USEPA, Soil Screening Guidance, 1996b.

(c) LLNL, 1987.

(d) Value for pure chlordane.

(e) Burrows *et al.*, 1989.

(f) USEPA Region III, CREST Model, 1993.

(g) USEPA, CHEMDATA, 1996d.

(h) ATSDR, Toxicological Profile for PAHS, 1995a.

(i) ATSDR, Toxicological Profile for Endosulfan, 1993c.

(j) ATSDR, Toxicological Profile for Naphthalene, 1995c.

Source: QST, 1998.

Table 7-19. Physiocochemical Properties for the Inorganic EcoCOPCs

Inorganic EcoCOPC	Atomic Weight (g/mol)	Water Solubility* (mg/L @ 25°C)	Kd† (L/kg)	Boiling Point* (°C)	Melting Point* (°C)
Aluminum	27	Neg	1500	2327	660
Antimony	122	Neg	45	1635	630
Arsenic	75	Neg	200	615	817
Barium	137	Neg	60	137	1640
Cadmium	112	Neg	7	765	321
Cobalt	59	Neg	45	2870	1493
Copper	64	Neg	35	2567	1083
Cyanide, total	26	NA	NA	NA	NA
Lead	207	Neg	900	1740	328
Manganese	55	Neg	65	1962	1244
Mercury	201	Neg	10	357	-39
Nickel	59	Neg	150	2732	1453
Silver	108	Neg	45	2000	960
Sulfate	64	NA	NA	NA	NA
Vanadium	51	Neg	1000	3380	1917
Zinc	65	Neg	40	908	420

COPC = constituent of potential concern

°C = degrees Celsius

g/mole = grams per mole

Kd = soil-water distribution coefficient.

L/kg = liters per kilogram

mg/L = milligrams per liter

NA = not applicable; compound-specific value.

Neg = negligible for elemental metal. Solubility is dependent on the speciation reactions in water.

\* Values for HSDB, TOMES CD/ROM, Volume 33 (exp. 7/31/97), unless otherwise specified.

† Values are rough estimates and are not meant to be used as exact measurements of coefficient values (ORNL, 1984).

Source: QST, 1998.

Table 7-20. Wildlife Species Potentially Found or Observed at Fort Sheridan, Illinois  
(Page 1 of 2)

Common Name	Scientific Name	State Status	Federal Status
<b><u>Mammals</u></b>			
Eastern chipmunk	<i>Tamias striatus</i>		
Eastern cottontail	<i>Sylvilagus floridanus</i>		
Eastern mole	<i>Scalopus aquaticus</i>		
Gray squirrel	<i>Sciurus carolinensis</i>		
Meadow vole	<i>Microtus pennsylvanicus</i>		
Opossum	<i>Didelphis marsupialis</i>		
Raccoon	<i>Procyon lotor</i>		
Striped skunk	<i>Mephitis mephitis</i>		
White footed mouse	<i>Peromyscus leucopus</i>		
White tail deer	<i>Odocoileus virginianus</i>		
Woodchuck	<i>Marmota monax</i>		
<b><u>Reptiles and Amphibians</u></b>			
American toad	<i>Bufo americanus</i>		
Chicago garter snake	<i>Thamnopsis sirtalis semifasciata</i>		
Eastern hognose snake	<i>Heterodon platyrhinos</i>		
Eastern plains garter snake	<i>Thamnophis radix</i>		
Eastern tiger salamander	<i>Ambystoma tigrinum tigrinum</i>		
Fowler's toad	<i>Bufo woodhousei fowleri</i>		
Fox snake	<i>Elaphe vulpina</i>		
Green frog	<i>Rana clamitans melanota</i>		
Snapping turtle	<i>Chelydra serpentina</i>		
Stinkpot	<i>Sternotherus odoratus</i>		
Western chorus frog	<i>Pseudacris triseriata triseriata</i>		
<b><u>Birds†</u></b>			
American crow	<i>Corvus brachyrhynchos</i>		
American robin	<i>Turdus migratorius</i>		
Bald eagle*	<i>Haliaeetus leucocephalus</i>	E	T
Barn swallow	<i>Hirundo rustica</i>		
Black-capped chickadee	<i>Cyanocitta cristata</i>		
Bluejay	<i>Cyanocitta cristata</i>		
Black and white warbler	<i>Mniotilta varia</i>	WL	
Brown creeper*	<i>Certhia familiaris</i>	T	
Brown-headed cowbird	<i>Molothrus ater ater</i>		
Brown thrasher	<i>Toxostoma rufum</i>		
Cardinal	<i>Cardinalis cardinalis</i>		
Chimney swift	<i>Chaetura pelagica</i>		
Common snipe	<i>Capella gallinago</i>	WL	
Common tern*	<i>Sterna hirundo</i>		
Cooper's Hawk	<i>Accipiter cooperii</i>	E	
Double-crested cormorant	<i>Phalacrocorax auritus</i>	T	
Downy woodpecker	<i>Picoides pubescens</i>		
Ducks	Family Anatidae		

Table 7-20. Wildlife Species Potentially Found or Observed at Fort Sheridan, Illinois  
(Page 2 of 2)

Common Name	Scientific Name	State Status	Federal Status
European starling	<i>Sturnus vulgaris vulgaris</i>		
Forster's tern*	<i>Sterna forsteri</i>	E	
Goldfinch	<i>Spinus tristis</i>		
Grackle	<i>Quiscalus quiscula</i>		
Gray catbird	<i>Dumetella carolinensis</i>		
Hawks	Family Accipitridae		
Herring gull	<i>Larus argentatus</i>		
Hooded merganser	<i>Lophodytes cucullatus</i>	WL	
Killdeer	<i>Charadrius vociferus</i>		
Least flycatcher	<i>Empidonax minimus</i>	WL	
Mourning dove	<i>Zenaida macroura</i>		
Northern oriole	<i>Icterus sp.</i>		
Osprey	<i>Pandion haliaetus</i>	E	
Ovenbird	<i>Seiurus aurocapillus</i>	WL	
Peregrine falcon*	<i>Falco peregrinus</i>		
Piping plover*	<i>Charadrius melodus</i>		
Purple finch	<i>Carpodacus purpureus</i>		
Red-bellied woodpecker	<i>Centurus carolinus</i>		
Red-winged blackbird	<i>Agelaius phoeniceus</i>		
Ring-billed gull	<i>Larus delawarensis</i>		
Rock dove	<i>Columba livia</i>		
SlatE-colored junco	<i>Junco hyemalis</i>		
Sparrows	<i>Passer spp.</i>		
Tufted titmouse	<i>Parus bicolor</i>		
Veery*	<i>Catharus fuscescens</i>	T	
Wood thrush	<i>Hylocichla mustelina</i>	WL	
Yellow-shafted flicker	<i>Colaptes auratus</i>		

\* Migratory species

† Many additional bird species have been observed in the most recent surveys.

T=threatened; E=endangered; WL=Illinois watch list

Source: USACE, 1990.  
Gross *et al.*, 1982.  
U.S. Navy, 1995.



Table 7-21. Common Fish Species in Lake Michigan

Common Name	Scientific Name
Sea lamprey	<i>Petromyzon marinus</i>
Lake sturgeon	<i>Acipenser fulvescens</i>
Alewife	<i>Alosa pseudoharengus</i>
Lake whitefish	<i>Coregonus clupeaformis</i>
Blackfin cisco	<i>C. nigripinnis</i>
Deepwater cisco	<i>C. johannae</i>
Longjaw cisco	<i>C. alpenae</i>
Shortjaw cisco	<i>C. zenithicus</i>
Bloater	<i>C. hoyi</i>
Kiyi	<i>C. kiyi</i>
Shortnose cisco	<i>C. reighardi</i>
Lake herring	<i>C. artedii</i>
Round whitefish	<i>Prosopium cylindraceum</i>
Lake trout	<i>Salvelinus namaycush</i>
Brook trout	<i>S. fontinalis</i>
Rainbow trout (steelhead)	<i>Salmo gairdneri</i>
Brown trout	<i>S. trutta</i>
Coho salmon	<i>Oncorhynchus kisutch</i>
Chinook salmon	<i>O. tshawytscha</i>
Rainbow smelt	<i>Osmerus mordax</i>
Northern pike	<i>Esox lucius</i>
Carp	<i>Cyprinus carpio</i>
Emerald shiner	<i>Notropis atherinoides</i>
Spottail shiner	<i>N. hudsonius</i>
Longnose sucker	<i>Catostomus catostomus</i>
White sucker	<i>C. commersoni</i>
Channel catfish	<i>Ictalurus punctatus</i>
Bullheads	<i>I. sp.</i>
Trout-perch	<i>Percopsis omiscomaycus</i>
Burbot	<i>Lota lota</i>
Ninespine stickleback	<i>Pungitius pungitius</i>
Smallmouth bass	<i>Micropterus dolomieu</i>
Yellow perch	<i>Perca flavescens</i>
Walleye	<i>Stizostedion vitreum vitreum</i>
Freshwater drum	<i>Aplodinotus grunniens</i>
Slimy sculpin	<i>Cottus cognatus</i>
Spoonhead sculpin	<i>C. ricei</i>
Fourhorn sculpin	<i>Myoxocephalus quadricornis</i>

Source: Wells and McClain, 1973.

Table 7-22. Food Intake Rates (IR) of Receptor Species

Receptor Species	IR (kg/day)	Reference	Comments
Woodchuck	0.206	EPA/600/R-93/187a	Estimated using BW and equation from EPA/600/R-93/187a
Short-tailed Shrew	0.009	EPA/600/R-93/187a	None
Feral cat	0.10	Sax, 1984	None
Raccoon	0.299	EPA/600/R-93/187a	None
Common Snipe	0.15	Sheldon, 1975	Value for American Woodcock

BW = body weight.

Source: QST, 1998.

Table 7-23. Fraction of Medium Ingested (FI) by Receptor Species

Receptor Species	Exposure Medium	FI	Reference	Comments
Woodchuck	water (for both ravines)	1.00	Burt, 1980	Home range: distance between ravines
Short-tailed Shrew	water	1.00	EPA/600/R-93/187a	
Feral Cat	water (for both ravines)	1.00	Carol Haspel (verbal)	Home range covers 1 ravine; therefore, FI for a ravine is 1.0
Raccoon	sediment	0.005	EPA/600/R-93/187a	Home range: 4,157 acres (greater than average ravine size of 19.5 acres)
	water	0.005	EPA/600/R-93/187a	
	prey	0.005	EPA/600/R-93/187a	
Common Snipe	sediment	0.11		Home range: 72 acres (average for male birds)
	invertebrates	0.11		

Source: QST, 1998.

Table 7-24. Exposure Frequency (EF) of Receptor Species

Receptor Species	Exposure Medium	EF (days/year)	Reference	Comments
Woodchuck	water	245	Lowery, 1974	
Short-tailed Shrew	water	365	EPA/600/R-93/187a	
Feral cat	water	365	Carol Haspel (verbal)	
	sediment	51	EPA/600/R-93/187a	None
Raccoon	water	51	EPA/600/R-93/187a	
	prey	51	EPA/600/R-93/187a	
Common Snipe	sediment	1.0		Based on home range. Migration period of 4 months.
	prey (invertebrates)	1.0		

Source: QST, 1998.

Table 7-25. Exposure Duration (ED) of Receptor Species

Receptor Species	Exposure Medium	ED (years)	Reference	Comments
Woodchuck	water	5	Burt, 1980	None
Short-tailed Shrew	water	0.38	EPA/600/R-93/187a	Mean age of male and female
Feral cat	water	5	Verbal Communication	Animal Control Center (Florida)
Raccoon	sediment/water/prey	3.1	EPA/600/R-93/187a	None
Common Snipe	sediment/prey (invertebrates)	8	EPA/600/R-93/187a	Maximum age for American Woodcock

7 Source: QST, 1998.

7-63

Table 7-26. Body Weight (BW) of Receptor Species

Receptor Species	BW (kg)	Reference	Comments
Woodchuck	3.8	Lowery, 1974	None
Short-tailed Shrew	0.015	EPA/600/R-93/187a	None
Feral cat	2	Sax, 1989	None
Raccoon	5.98	EPA/600/R-93/187a	Average of data from Illinois (1984) study
Common Snipe	0.111	Glutz <i>et al.</i> , 1977	None

kg = kilograms

Source: QST, 1998.

Table 7-27. Averaging Time (AT) of Receptor Species

Receptor Species	AT (days)	Reference
Woodchuck	1825	Burt, 1980
Short-tailed Shrew	139	EPA/600/R-93/187a
Feral cat	1825	Animal Control Center (Florida)
Raccoon	1132	EPA/600/R-93/187a
Common Snipe	2920	Birds of North America, #100, 1994

Source: QST, 1998.

Table 7-28. Fraction of Diet Consisting of Exposure Medium (D) of Receptor Species

Receptor Species	Exposure Medium	D	Reference	Comments
Raccoon	sediment	0.094	EPA/600/R-93/187a	None
Common Snipe	sediment	0.104	USEPA, 1993b EPA/600/R-93/187a	Value for American Woodcock.
	invertebrates	0.678	USEPA, 1993b EPA/600/R-93/187a	

Source: QST, 1998.



Table 7-29. Water Intake Rates (IRw) of Receptor Species

Receptor Species	IRw (L/day)	Reference
Woodchuck	0.329	Lowery, 1974
Short-tailed shrew	0.0033	EPA/600/R-93/187a
Raccoon	0.5	EPA/600/R-93/187a
Feral cat	0.1	Sax, 1989

Note: Woodchuck and raccoon values were calculated from body weight (EPA/600/R-93/187a)

L/day = liters per day

Source: QST, 1998.

Table 7-30. Ecotoxicity Benchmarks for Surface Water Ingestion by Four Terrestrial Species (Page 1 of 4)

ListCode	Constituent/ Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint Species	Endpoint Species bw (kg)	Endpoint Wildlife Value (mg/kg/day)	IRw (L/day)	Surface Water Benchmark (mg/L)	Comments
ANTRC	Anthracene	Mouse	0.35	1000	LOAEL	Shrew	0.015	2.86E+03	0.0033	1.30E+04	ATSDR, 1997
		Mouse	0.35	1000	LOAEL	Feral Cat	2	5.59E+02	0.1	1.12E+04	ATSDR, 1997
		Mouse	0.35	1000	LOAEL	Woodchuck	3.8	4.52E+02	0.329	5.22E+03	ATSDR, 1997
		Mouse	0.35	1000	LOAEL	Raccoon	5.98	3.88E+02	0.5	4.64E+03	ATSDR, 1997
BA	Barium (Barium chloride)	Rat	0.435	5.1	NOAEL	Shrew	0.015	1.57E+01	0.0033	7.12E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.435	5.1	NOAEL	Feral Cat	2	3.07E+00	0.1	6.13E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.435	5.1	NOAEL	Woodchuck	3.8	2.48E+00	0.329	2.86E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.435	5.1	NOAEL	Raccoon	5.98	2.13E+00	0.5	2.55E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
BAPYR	Benzo(a)pyrene	Mouse	0.03	10	LOAEL	Shrew	0.015	1.26E+01	0.0033	5.73E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Mouse	0.03	10	LOAEL	Feral Cat	2	2.47E+00	0.1	4.93E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Mouse	0.03	10	LOAEL	Woodchuck	3.8	1.99E+00	0.329	2.30E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Mouse	0.03	10	LOAEL	Raccoon	5.98	1.71E+00	0.5	2.05E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3

Table 7-30. Ecotoxicity Benchmarks for Surface Water Ingestion by Four Terrestrial Species (Page 2 of 4)

ListCode	Constituent/ Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint Species	Endpoint Species bw (kg)	Endpoint Wildlife Value (mg/kg/day)	IRw (L/day)	Surface Water Benchmark (mg/L)	Comments
CYN	Cyanide, total (Potassium cyanide)	Rat	0.273	68.7	NOAEL	Shrew	0.015	1.81E+02	0.0033	8.21E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.273	68.7	NOAEL	Feral Cat	2	3.54E+01	0.1	7.07E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.273	68.7	NOAEL	Woodchuck	3.8	2.86E+01	0.329	3.30E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.273	68.7	NOAEL	Raccoon	5.98	2.46E+01	0.5	2.94E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
PPDDD	DDD, p,p'/ DDT, p,p'	Rat	0.35	4	LOAEL	Shrew	0.015	1.14E+01	0.0033	5.20E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	4	LOAEL	Feral Cat	2	2.24E+00	0.1	4.47E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	4	LOAEL	Woodchuck	3.8	1.81E+00	0.329	2.09E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	4	LOAEL	Raccoon	5.98	1.55E+00	0.5	1.86E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
PPDDE	DDE, p,p'/ DDT, p,p'	Rat	0.35	4	LOAEL	Shrew	0.015	1.14E+01	0.0033	5.20E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	4	LOAEL	Feral Cat	2	2.24E+00	0.1	4.47E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	4	LOAEL	Woodchuck	3.8	1.81E+00	0.329	2.09E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	4	LOAEL	Raccoon	5.98	1.55E+00	0.5	1.86E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3

Table 7-30. Ecotoxicity Benchmarks for Surface Water Ingestion by Four Terrestrial Species (Page 3 of 4)

ListCode	Constituent/ Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint Species	Endpoint Species bw (kg)	Endpoint Wildlife Value (mg/kg/day)	IRw (L/day)	Surface Water Benchmark (mg/L)	Comments
PPDDT	DDT, p,p'-	Rat	0.35	4	LOAEL	Shrew	0.015	1.14E+01	0.0033	5.20E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	4	LOAEL	Feral Cat	2	2.24E+00	0.1	4.47E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	4	LOAEL	Woodchuck	3.8	1.81E+00	0.329	2.09E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	4	LOAEL	Raccoon	5.98	1.55E+00	0.5	1.86E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
CL10BP	Decachloro- biphenyl/ Nonspecific PCB	Rat	0.35	2.5	LOAEL	Shrew	0.015	7.14E+00	0.0033	3.25E+01	ATSDR, 1997; NCI, 1978
		Rat	0.35	2.5	LOAEL	Feral Cat	2	1.40E+00	0.1	2.80E+01	ATSDR, 1997; NCI, 1978
		Rat	0.35	2.5	LOAEL	Woodchuck	3.8	1.13E+00	0.329	1.30E+01	ATSDR, 1997; NCI, 1978
		Rat	0.35	2.5	LOAEL	Raccoon	5.98	9.71E-01	0.5	1.16E+01	ATSDR, 1997; NCI, 1978
MN	Manganese (Manganese oxide)	Rat	0.35	284	LOAEL	Shrew	0.015	8.12E+02	0.0033	3.69E+03	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	284	LOAEL	Feral Cat	2	1.59E+02	0.1	3.18E+03	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	284	LOAEL	Woodchuck	3.8	1.28E+02	0.329	1.48E+03	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.35	284	LOAEL	Raccoon	5.98	1.10E+02	0.5	1.32E+03	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
PYR	Pyrene/Benzo(a) pyrene	Mouse	0.03	10	LOAEL	Shrew	0.015	1.26E+01	0.0033	5.73E+01	ATSDR, 1997
		Mouse	0.03	10	LOAEL	Feral Cat	2	2.47E+00	0.1	4.93E+01	ATSDR, 1997
		Mouse	0.03	10	LOAEL	Woodchuck	3.8	1.99E+00	0.329	2.30E+01	ATSDR, 1997
		Mouse	0.03	10	LOAEL	Raccoon	5.98	1.71E+00	0.5	2.05E+01	ATSDR, 1997

Table 7-30. Ecotoxicity Benchmarks for Surface Water Ingestion by Four Terrestrial Species (Page 4 of 4)

ListCode	Constituent/ Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint Species	Endpoint Species bw (kg)	Endpoint Wildlife Value (mg/kg/day)	IRw (L/day)	Surface Water Benchmark (mg/L)	Comments
SO4	Sulfate (Thallium sulfate)	Rat	0.365	0.0074	NOAEL	Shrew	0.015	2.14E-02	0.0033	9.75E-02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.365	0.0074	NOAEL	Feral Cat	2	4.20E-03	0.1	8.39E-02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.365	0.0074	NOAEL	Woodchuck	3.8	3.39E-03	0.329	3.91E-02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
		Rat	0.365	0.0074	NOAEL	Raccoon	5.98	2.91E-03	0.5	3.48E-02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3

mg/L = milligrams per liter

kg = kilogram

mg/kg/day = milligrams per kilogram per day

L/day = liters per day.

bw = body weight

LOAEL / NOAEL = lowest / no observed adverse effects level (mg/kg-d)

IRw = water ingestion rate (L/day) for endpoint species

Surface Water Benchmark = (Endpoint Wildlife value \* bw) / IRw ; the concentration in surface water resulting in dose equivalent to the endpoint wildlife value

Source: QST, 1998.

Table 7-31. Summary of Ecotoxicity Benchmark Values and Observed Effects of Selected EcoCOPCs on Fowler's Toad (*Bufo woodhousei fowleri*)

ListCode	Additional Code	Stat	Concentration	Units	Exp	Effect/Comments
PPDDT	DDT, p,p'-	LC50	1	mg/L	96th	Tadpole 4-5 weeks old
PPDDT	DDT, p,p'-	LC50	0.0087	mg/L	96th	Tadpole 6 weeks old
PPDDT	DDT, p,p'-	LC50	0.03	mg/L	96th	7 weeks old

COPC = constituent of potential concern

LC<sub>50</sub> = median lethal concentration (a concentration where mortality is observed in 50 percent of the study species.

mg/L = milligrams per liter.

Source: QST, 1998.

Table 7-32. Ecotoxicity Benchmarks for Aquatic Invertebrates Potentially Exposed to Surface Water in Janes and Hutchinson Ravines and the Beach Area

ListCode	Constituent/Surrogate	Benchmark	Units	Type	Species	Comments
ANTRC	Anthracene	2.10e-03	mg/L	Chronic	Daphnids	Suter II and Tsao, 1996
BAPYR	Benzo(a)pyrene	3.00e-04	mg/L	Chronic	Daphnids	Suter II and Tsao, 1996
BA	Barium	5.80e+00	mg/L:	Chronic	Daphnids	Suter II and Tsao, 1996
CYN	Cyanide, total	1.83e-02	mg/L	Chronic	Nondaphnid species	Suter II and Tsao, 1996
PPDDD	DDD, p,p'-	3.20e-03	mg/L	LC <sub>50</sub>	Daphnids	48 hours; Trans. Amer. Fish Soc. 95(2):165, 1966
PPDDE	DDE, p,p'-/DDT, p,p'-	1.60e-05	mg/L	Chronic	Daphnids	Suter II and Tsao, 1996
PPDDT	DDT, p,p'-	1.60e-05	mg/L	Chronic	Daphnids	Suter II and Tsao, 1996
CL10BP	Decachlorobiphenyl	2.10e-03	mg/L	Chronic	Daphnids	Suter II and Tsao, 1996
MN	Manganese	1.10e+00	mg/L	Chronic	Daphnids	Suter II and Tsao, 1996
PYR	Pyrene/Benzo(a)pyrene	3.00e-04	mg/L	Chronic	Daphnids	Suter II and Tsao, 1996

mg/L = milligrams per liter.

LC<sub>50</sub> = medial lethal concentration (a concentration where mortality is observed in 50 percent of the study species)

Source: QST, 1998.

Table 7-33. Ecotoxicity Benchmarks for Benthic Invertebrates Exposed to Sediment in Lake Michigan

ListCode	Constituent/Surrogate	Benchmark	Units	Type	Reference
AL	Aluminum	1.00E+03	mg/kg	BTAG	Region III value for soil invertebrate
13DNB	Dinitrobenzene, 1,3-	1.91E-01	mg/kg	SQC*	Talmage and Opresko, 1995

BTAG = Biological Technical Assistance Group

mg/kg = milligrams per kilogram

SQC = sediment quality criteria

TOC = total organic carbon

\* Benchmark calculated using Secondary Chronic Value and Beach Area TOC of 17.7%.

Source: QST, 1998.



Table 7-34. Ecotoxicity Benchmarks for Sediment EcoCOPC Ingestion by Raccoons in Janes and Hutchinson Ravines and the Beach Area  
(Page 1 of 2)

ListCode	Constituent/Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Wildlife Value (Raccoon)	Endpoint Value (mg/kg)	Sediment Benchmark†	Comments
245T	2,4,5-T	Rat	0.35	10	LOAEL	3.88E+00	8.29E+02	Kociba <i>et al.</i> , 1979 (NIOSH, 1997)	
ANAPNE	Acenaphthene	Mouse	0.03	175	NOAEL	3.00E+01	6.40E+03	ATSDR, 1997	
ANAPYL	Acenaphthylene/Benzo(a)pyrene	Mouse	0.03	10	NOAEL	1.71E+00	3.66E+02	Neal and Rigdon, 1967 (ATSDR, 1990)	
ALDRN	Aldrin	Rat	0.35	1	LOAEL	3.88E-01	8.29E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
AL	Aluminum (AlCl3)	Mouse	0.03	19.3	LOAEL	3.30E+00	7.06E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
ANTRC	Anthracene	Mouse	0.03	1000	LOAEL	1.71E+02	3.66E+04	ATSDR, 1997	
SB	Antimony	Mouse	0.03	1.25	LOAEL	2.14E-01	4.57E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
AS	Arsenic	Mouse	0.03	0.126	NOAEL	2.16E-02	4.61E+00	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
BAANTR	Benzo(a)anthracene	Mouse	0.03	13.3	NOAEL	2.28E+00	4.86E+02	Neal and Rigdon, 1967 (ATSDR, 1990)	
BAPYR	Benzo(a)pyrene	Mouse	0.03	10	LOAEL	1.71E+00	3.66E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
BBFANT	Benzo(b)fluoranthene	Mouse	0.03	13.3	NOAEL	2.28E+00	4.86E+02	Neal and Rigdon, 1967 (ATSDR, 1990)	
BGHIPI	Benzo(g,h,i)perylene	Mouse	0.03	13.3	NOAEL	2.28E+00	4.86E+02	Neal and Rigdon, 1967 (ATSDR, 1990)	
BKFANT	Benzo(k)fluoranthene/Benzo(a)pyrene	Mouse	0.03	10	LOAEL	1.71E+00	3.66E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
CD	Cadmium	Rat	0.35	10	LOAEL	3.88E+00	8.29E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
CARBAZ	Carbazole/Benzo(a)pyrene	Mouse	0.03	10	LOAEL	1.71E+00	3.66E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
ACLDAN	Chlordane, alpha-/Chlordane, total	Mouse	0.03	9.2	LOAEL	1.57E+00	3.36E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
GCILDAN	Chlordane, gamma-/Chlordane, total	Mouse	0.03	9.2	LOAEL	1.57E+00	3.36E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
CLDAN	Chlordane, total	Mouse	0.03	9.2	LOAEL	1.57E+00	3.36E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
CHRY	Chrysene	Mouse	0.03	13.3	NOAEL	2.28E+00	4.86E+02	Neal and Rigdon, 1967 (ATSDR, 1990)	
CYN	Cyanide, total (Potassium Cyanide)	Rat	0.273	68.7	NOAEL	2.46E+01	5.24E+03	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
PPDDT	DDT, p,p'-	Rat	0.35	4	LOAEL	1.55E+00	3.32E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
PPDDD	DDD, p,p'-DDT, p,p'-	Rat	0.35	4	LOAEL	1.55E+00	3.32E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
PPDDE	DDE, p,p'-DDE, p,p'-	Rat	0.35	4	LOAEL	1.55E+00	3.32E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
DBAHA	Dibenzo(ah)anthracene	Mouse	0.03	13.3	NOAEL	2.28E+00	4.86E+02	Neal and Rigdon, 1967 (ATSDR, 1990)	
ENDRN	Endrin	Mouse	0.03	0.92	LOAEL	1.57E-01	3.36E+01	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3	
FANT	Fluoranthene	Mouse	0.03	500	LOAEL	8.56E+01	1.83E+04	ATSDR, 1997	
FLRENE	Fluorene	Mouse	0.03	125	LOAEL	2.14E+01	4.57E+03	EPA, 1989 (ATSDR, 1997)	

Table 7-34. Ecotoxicity Benchmarks for Sediment EcoCOPC Ingestion by Raccoons in Janes and Hutchinson Ravines and the Beach Area  
(Page 2 of 2)

ListCode	Constituent/Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint Wildlife Value (Raccoon)	Sediment Benchmark† (mg/kg)	Comments
LIN	Hexachlorocyclohexane, gamma-(Lindane)/BHC, alpha-	Rat	0.35	8	NOAEL	3.11E+00	6.63E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
ICDPYR	Indeno(1,2,3-cd)pyrene	Mouse	0.03	13.3	NOAEL	2.28E+00	4.86E+02	Neal and Rigdon, 1967 (ATSDR, 1990)
MN	Manganese	Rat	0.35	284	LOAEL	1.10E+02	2.36E+04	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
HG	Mercury (Mercuric Chloride)	Mink	1	1	NOAEL	5.51E-01	1.18E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
MEXCLR	Methoxychlor	Rat	0.35	8	LOAEL	3.11E+00	6.63E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
2MNAP	Methynaphthalene, 2-/Naphthalene	Rat	0.35	50	LOAEL	1.94E+01	4.15E+03	ATSDR, 1997
NAP	Naphthalene	Rat	0.35	50	LOAEL	1.94E+01	4.15E+03	ATSDR, 1997
NI	Nickel	Rat	0.35	80	LOAEL	3.11E+01	6.63E+03	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
PHANTR	Phenanthrene/Benzo(a)pyrene	Mouse	0.03	10	LOAEL	1.71E+00	3.66E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
PYR	Pyrene/Benzo(a)pyrene	Mouse	0.03	10	LOAEL	1.71E+00	3.66E+02	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3
AG	Silver	Rat	0.35	101.2	NOAEL	3.93E+01	8.39E+03	Walker, 1971 (ATSDR, 1997)
ZN	Zinc	Rat	0.35	320	LOAEL	1.24E+02	2.65E+04	Sample <i>et al.</i> , 1996/ES/ER/TM-86/R3

bw = body weight

kg = kilogram

mg/kg/day = milligrams per kilogram per day

LOAEL / NOAEL = lowest / no observed adverse effects level (mg/kg-d)

Sediment Benchmark = Endpoint Wildlife Value / f; the concentration in sediment resulting in dose equivalent to the endpoint wildlife value

\* No benchmark data available

† Benchmark is based on racoon bw of 5.98 kg, sediment ingestion rate of 0.028 kg/day, and a food factor f (food consumed per unit body weight) = IR/bw = 0.004682

Source: QST 1998.

Table 7-35. Ecotoxicity Benchmarks for Ingestion of Beach Area Sediment EcoCOPCs by Snipes

ListCode	Constituent/ Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint Species	Endpoint Species bw (kg)	Wildlife Value (mg/kg/day)	IRmed (kg/day)	f (1/day)	Benchmark (mg/kg)	Intake Comments
AL	Aluminum (Al(SO <sub>4</sub> ) <sub>2</sub> )	Ringed Dove	0.155	109.7	NOAEL	Common Snipe	0.111	1.23E+02	1.72E-03	1.55E-02	7.93E+03	Sample et al
AS	Arsenic	Cowbird	0.049	2.46	NOAEL	Common Snipe	0.111	1.87E+00	1.72E-03	1.55E-02	1.21E+02	Sample et al
CLDAN	Chlordane, total	Red-winged Blackbird	0.064	2.14	NOAEL	Common Snipe	0.111	1.78E+00	1.72E-03	1.55E-02	1.15E+02	Sample et al
PPDDD	DDD, p,p'/DDT, p,p'	Brown Pelican	3.5	0.028	LOAEL	Common Snipe	0.111	8.85E-02	1.72E-03	1.55E-02	5.72E+00	Sample et al
PPDDE	DDE, p,p'/DDT, p,p'	Brown Pelican	3.5	0.028	LOAEL	Common Snipe	0.111	8.85E-02	1.72E-03	1.55E-02	5.72E+00	Sample et al
PPDDT	DDT, p,p'-	Brown Pelican	3.5	0.028	LOAEL	Common Snipe	0.111	8.85E-02	1.72E-03	1.55E-02	5.72E+00	Sample et al
LIN	Hexachlorocyclo hexane, gamma- (Lindane)	Mallard Duck	1	2	NOAEL	Common Snipe	0.111	4.16E+00	1.72E-03	1.55E-02	2.69E+02	Sample et al
MN	Manganese	Japanese Quail	0.072	977	NOAEL	Common Snipe	0.111	8.46E+02	1.72E-03	1.55E-02	5.47E+04	Sample et al
NI	Nickel (Nickel sulfate)	Mallard Duckling	0.782	77.4	NOAEL	Common Snipe	0.111	1.48E+02	1.72E-03	1.55E-02	9.60E+03	Sample et al
ZN	Zinc	Chicken	1.935	14.5	NOAEL	Common Snipe	0.111	3.76E+01	1.72E-03	1.55E-02	2.43E+03	Sample et al

bw = body weight COPC = constituent of potential concern kg = kilograms mg/kg/day = milligrams per kilogram per day f = food factor

LOAEL / NOAEL = lowest / no observed adverse effects level (mg/kg-d)

IRmed = ingestion rate of medium-soil or sediment- (kg/day) for endpoint species = IR \* % sed or soil ingested in diet \* FI, where FI = fraction of medium ingested from the study area.

Intake Benchmark = Endpoint Wildlife value /f the concentration in sediment or soil resulting in dose equivalent to the endpoint wildlife value; food factor f (food consumed per unit body weight = IR/bw.

Source: QST, 1998.

Table 7-36. Ecotoxicity Benchmarks for Snipe Ingestion of Beach Area Sediment EcoCOPCs

ListCode	Constituent/Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint Species	Endpoint Species bw (kg)	Endpoint Wildlife Value (mg/kg/day)	IRmed (kg/day)	f (1/day)	Sediment Intake Benchmark (mg/kg)
SB	Antimony (Antimony potassium tartrate)	Lab Mouse	NA	0.125	NOAEL	Composite Bird	0.85	3.57E-01			
		Composite Bird	0.85	7.03E-01	Reg. NOAEL	Snipe	0.111	7.03E-01	1.72E-03	1.55E-02	4.55E+01

Note: NA = not applicable to determine snipe benchmarks.

Endpoint Wildlife Values (EWV): For the composite bird as the endpoint species, the EWV was determined from the following regression equation (Shortelle et al., 1997):  $\exp[0.55 + 0.76(\ln(\text{original value}))]$ .

For the snipe as the endpoint species, the EWV was determined from the following equation:  
original value  $\times$  (organism bw / endpoint species bw) $^{(1/3)}$ .

IRmed = Ingestion rate of soil/sed for endpoint species =  $\text{IR} \times \%_{\text{sed}}$  or soil ingested in diet  $\times \text{FI}$ , where FI = fraction of medium ingested from the study area

bw = body weight

COPC = constituent of potential concern

f = food factor (food consumed per unit body weight) =  $\text{IR}/\text{bw}$

kg = kilograms

mg/kg/day = milligrams per kilogram per day

LOAEL/NOAEL = lowest/no observed adverse effects level.

Source: QST, 1998.

Table 7-37. Ecotoxicity Benchmarks for Ingestion of *L. variegatus* by Raccoons in Janes and Hutchinson Ravines and the Beach Area (Page 1 of 3)

ListCode	Constituents/ Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint		f (1/day)	Worm Ingestion Benchmark (mg/kg)	Comments
						Wildlife Value (Raccoon)				
245T	2,4,5-T	Rat	0.35	10	LOAEL	3.88E+00		0.003679	1.06E+03	Kociba <i>et al.</i> , 1979 (NIOSH, 1997)
ANAPNE	Acenaphthene	Mouse	0.03	175	NOAEL	3.00E+01		0.003679	8.14E+03	ATSDR, 1997
ANAPYL	Acenaphthylene/ Benzo(a)pyrene	Mouse	0.03	10	NOAEL	1.71E+00		0.003679	4.65E+02	Neal and Rigdon, 1967 (ATSDR, 1990)
ALDRN	Aldrin	Rat	0.35	1	LOAEL	3.88E-01		0.003679	1.06E+02	Sample <i>et al.</i> , 1996
AL	Aluminum (AlCl3)	Mouse	0.03	19.3	LOAEL	3.30E+00		0.003679	8.98E+02	Sample <i>et al.</i> , 1996
SB	Antimony	Mouse	0.03	1.25	LOAEL	2.14E-01		0.003679	5.82E+01	Sample <i>et al.</i> , 1996
ANTRC	Anthracene	Mouse	0.03	1000	LOAEL	1.71E+02		0.003679	4.65E+04	ATSDR, 1997
AS	Arsenic	Mouse	0.03	0.126	NOAEL	2.16E-02		0.003679	5.86E+00	Sample <i>et al.</i> , 1996
BAANTR	Benzo(a)anthracene	Mouse	0.03	13.3	NOAEL	2.28E+00		0.003679	6.19E+02	Neal and Rigdon, 1967 (ATSDR, 1990)
BAPYR	Benzo(a)pyrene	Mouse	0.03	10	LOAEL	1.71E+00		0.003679	4.65E+02	Sample <i>et al.</i> , 1996
BBFANT	Benzo(b)fluoranthene	Mouse	0.03	13.3	NOAEL	2.28E+00		0.003679	6.19E+02	Neal and Rigdon, 1967 (ATSDR, 1990)
BGHIPI	Benzo(g,h,i)perylene	Mouse	0.03	13.3	NOAEL	2.28E+00		0.003679	6.19E+02	Neal and Rigdon, 1967 (ATSDR, 1990)
BKFANT	Benzo(k)fluoranthene/ Benzo(a)pyrene	Mouse	0.03	10	LOAEL	1.71E+00		0.003679	4.65E+02	Sample <i>et al.</i> , 1996
B2EHP	Bis(2-ethylhexyl)phthalate	Mouse	0.03	183	LOAEL	3.13E+01		0.003679	8.52E+03	Sample <i>et al.</i> , 1996
CD	Cadmium	Rat	0.35	0.01	LOAEL	3.88E-03		0.003679	1.06E+00	Sample <i>et al.</i> , 1996
CARBAZ	Carbazole/ Benzo(a)pyrene	Mouse	0.03	10	LOAEL	1.71E+00		0.003679	4.65E+02	Sample <i>et al.</i> , 1996
ACLDAN	Chlordane, alpha-/ Chlordane, total	Mouse	0.03	9.2	LOAEL	1.57E+00		0.003679	4.28E+02	Sample <i>et al.</i> , 1996
GCLDAN	Chlordane, gamma-/ Chlordane, total	Mouse	0.03	9.2	LOAEL	1.57E+00		0.003679	4.28E+02	Sample <i>et al.</i> , 1996
CLDAN	Chlordane, total	Mouse	0.03	9.2	LOAEL	1.57E+00		0.003679	4.28E+02	Sample <i>et al.</i> , 1996
CR	Chromium, Total	Rat	0.35	13.14	LOAEL	5.10E+00		0.003679	1.39E+03	Sample <i>et al.</i> , 1996

Table 7-37. Ecotoxicity Benchmarks for Ingestion of *L. variegatus* by Raccoons in Janes and Hutchinson Ravines and the Beach Area (Page 2 of 3)

ListCode	Constituents/ Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint Wildlife Value (Raccoon)	f (1/day)	Worm Ingestion Benchmark (mg/kg)	Comments
CHRY	Chrysene	Mouse	0.03	13.3	NOAEL	2.28E+00	0.003679	6.19E+02	Neal and Rigdon, 1967 (ATSDR, 1990)
CYN	Cyanide, total (Potassium Cyanide)	Rat	0.273	68.7	NOAEL	2.46E+01	0.003679	6.67E+03	Sample <i>et al.</i> , 1996
PPDDT	DDT, p,p'-	Rat	0.35	4	LOAEL	1.55E+00	0.003679	4.22E+02	Sample <i>et al.</i> , 1996
PPDDD	DDD, p,p'-/DDT, p,p'-	Rat	0.35	4	LOAEL	1.55E+00	0.003679	4.22E+02	Sample <i>et al.</i> , 1996
PPDDE	DDE, p,p'-/DDE, p,p'-	Rat	0.35	4	LOAEL	1.55E+00	0.003679	4.22E+02	Sample <i>et al.</i> , 1996
DBAHA	Dibenzo(a,h)anthracene	Mouse	0.03	13.3	NOAEL	2.28E+00	0.003679	6.19E+02	Neal and Rigdon, 1967 (ATSDR, 1990)
ENDRN	Endrin	Mouse	0.03	0.92	LOAEL	1.57E-01	0.003679	4.28E+01	Sample <i>et al.</i> , 1996
FANT	Fluoranthene	Mouse	0.03	500	LOAEL	8.56E+01	0.003679	2.33E+04	ATSDR, 1997
FLRENE	Fluorene	Mouse	0.03	125	LOAEL	2.14E+01	0.003679	5.82E+03	EPA, 1989 (ATSDR, 1997)
LIN	Hexachlorocyclohexane , gamma- (Lindane)/ BHC, alpha-	Rat	0.35	8	NOAEL	3.11E+00	0.003679	8.44E+02	Sample <i>et al.</i> , 1996
ICDPYR	Indeno(1,2,3-cd)pyrene	Mouse	0.03	13.3	NOAEL	2.28E+00	0.003679	6.19E+02	Neal and Rigdon, 1967 (ATSDR, 1990)
PB	Lead	Rat	0.35	80	LOAEL	3.11E+01	0.003679	8.44E+03	Sample <i>et al.</i> , 1996
MN	Manganese	Rat	0.35	284	LOAEL	1.10E+02	0.003679	3.00E+04	Sample <i>et al.</i> , 1996
HG	Mercury (Mecuric Chloride)	Mink	1	1	NOAEL	5.51E-01	0.003679	1.50E+02	Sample <i>et al.</i> , 1996
MEXCLR	Methoxychlor	Rat	0.35	8	LOAEL	3.11E+00	0.003679	8.44E+02	Sample <i>et al.</i> , 1996
2MNAP	Methynaphthalene, 2-/ Naphthalene	Rat	0.35	50	LOAEL	1.94E+01	0.003679	5.28E+03	ATSDR, 1997
NAP	Naphthalene	Rat	0.35	50	LOAEL	1.94E+01	0.003679	5.28E+03	ATSDR, 1997
NI	Nickel	Rat	0.35	80	LOAEL	3.11E+01	0.003679	8.44E+03	Sample <i>et al.</i> , 1996
PHANTR	Phenanthrene/ Benzo(a)pyrene	Mouse	0.03	10	LOAEL	1.71E+00	0.003679	4.65E+02	Sample <i>et al.</i> , 1996

Table 7-37. Ecotoxicity Benchmarks for Ingestion of *L. variegatus* by Raccoons in Janes and Hutchinson Ravines and the Beach Area (Page 3 of 3)

ListCode	Constituents/ Surrogate	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint Wildlife Value (Raccoon)	f (1/day)	Worm Ingestion Benchmark (mg/kg)	Comments
PYR	Pyrene/Benzo(a)pyrene	Mouse	0.03	10	LOAEL	1.71E+00	0.003679	4.65E+02	Sample <i>et al.</i> , 1996
SE	Selenium (Selenate)	Mouse	0.03	0.76	LOAEL	1.30E-01	0.003679	3.54E+01	Sample <i>et al.</i> , 1996
AG	Silver	Rat	0.35	101.2	NOAEL	3.93E+01	0.003679	1.07E+04	Walker, 1971 (ATSDR, 1997)
ZN	Zinc	Rat	0.35	320	LOAEL	1.24E+02	0.003679	3.38E+04	Sample <i>et al.</i> , 1996

bw = body weight

kg = kilogram

mg/kg/day = milligrams per kilogram per day

LOAEL / NOAEL = lowest / no observed adverse effects level (mg/kg-d)

IRworm = worm ingestion rate (kg/day) for raccoons [percent diet worm tissue (.072) multiplied by food ingestion rate (.299 kg/day)].

f = food factor (food consumed per unit body weight) = IR/bw

Worm Ingestion Benchmark = Endpoint Wildlife Value / f; the concentration in worm tissue resulting in dose equivalent to the endpoint wildlife value.

\* = No benchmark data available

Source: QST, 1998.

Table 7-38. Ecotoxicity Benchmarks for EcoCOPCs Associated with the Ingestion of *L. variegatus* by Snipes at the Beach Area

ListCode	Constituent	Test Organism	Organism bw (kg)	Original Value (mg/kg/day)	Value Type	Endpoint Species	Endpoint Species bw (kg)	Endpoint Wildlife Value (mg/kg/day)	IRinv (kg/day)	f (1/day)	Food Intake Benchmark (mg/kg)	Comments
AL	Aluminum (Al(SO <sub>4</sub> ) <sub>2</sub> )	Ringed Dove	0.155	109.7	NOAEL	Common Snipe	0.111	1.23E+02	1.12E-02	1.01E-01	1.22E+03	Sample et al, 1996
AS	Arsenic	Cowbird	0.049	2.46	NOAEL	Common Snipe	0.111	1.87E+00	1.12E-02	1.01E-01	1.86E+01	Sample et al, 1996
CD	Cadmium	Mallard Duck	1.17	1.45	NOAEL	Common Snipe	0.111	3.18E+00	1.12E-02	1.01E-01	3.15E+01	Sample et al, 1996
CR	Chromium (total)	Black Duck	1.25	1	NOAEL	Common Snipe	0.111	3.30E-03	1.12E-02	1.01E-01	3.27E-02	Sample et al, 1996
PPDDD	DDD,p,p'/DDT, p,p'	Brown Pelican	3.5	0.028	LOAEL	Common Snipe	0.111	8.85E-02	1.12E-02	1.01E-01	8.78E-01	Sample et al, 1996
PPDDE	DDE, p,p'/DDT, p,p'	Brown Pelican	3.5	0.028	LOAEL	Common Snipe	0.111	8.85E-02	1.12E-02	1.01E-01	8.78E-01	Sample et al, 1996
PPDDT	DDT, p,p'-	Brown Pelican	3.5	0.028	LOAEL	Common Snipe	0.111	8.85E-02	1.12E-02	1.01E-01	8.78E-01	Sample et al, 1996
MN	Manganese	Japanese Quail	0.072	977	NOAEL	Common Snipe	0.111	3.30E-03	1.12E-02	1.01E-01	3.27E-02	Sample et al, 1996
NI	Nickel (Nickel sulfate)	Mallard Duckling	0.782	77.4	NOAEL	Common Snipe	0.111	1.48E+02	1.12E-02	1.01E-01	1.47E+03	Sample et al, 1996
SE	Selenium	Mallard Duck	1.17	0.5	NOAEL	Common Snipe	0.111	1.10E+00	1.12E-02	1.01E-01	1.09E+01	Sample et al, 1996
ZN	Zinc	Chicken	1.935	14.5	NOAEL	Common Snipe	0.111	3.76E+01	1.12E-02	1.01E-01	3.73E+02	Sample et al, 1996

bw = body weight

LOAEL / NOAEL = lowest / no observed adverse effects level (mg/kg-d)

IRinv = ingestion rate of Lumbriculus- (kg/day) for endpoint species = IR \* % invertebrates ingested in diet \* FI, where FI = fraction of invertebrates ingested from the study area.

Intake Benchmark = Endpoint Wildlife value / f ; the concentration in worms resulting in dose equivalent to the endpoint wildlife value

Source: QST, 1998.



## 8.0 Potential Ecological Risk Characterization

The environmental media and exposure pathways evaluated for ecological receptors are: (1) ingestion of sediments by avian, invertebrate and mammalian receptors; (2) ingestion of prey (e.g., *L. variegatus*) by avian and mammalian receptors; (3) ingestion of surface waters by mammalian receptors; (4) exposure of aquatic and benthic invertebrates to surface water or sediments; and (5) exposure of amphibians to surface water. Benchmark values corresponding with the appropriate measurement endpoints are compared with potential exposure concentrations. The development of the exposure concentrations is presented in Section 2.0 and Appendix I. The appropriate media considered for these assessments are surface water, groundwater, sediments, and biota. The estimated ecoCOPC concentrations for each medium were compared to the benchmarks as follows:

$$\text{Ecotoxicity Quotient} = \text{EcoCOPC Concentration} \div \text{Ecotoxicity Benchmark}$$

Ecotoxicity quotients (EQs) less than 1 suggest that the benchmark effect is unlikely to occur. Those instances where the individual EQs are greater than 1 require further evaluation. Although the EQ method does not provide an estimate of uncertainty and is not an estimation of potential risk, it is commonly used for screening the potential for ecological effects from exposure to hazardous constituents. Supplementing the EQ evaluation are site-specific data (bioassays and tissue body burdens).

The risk estimation was conducted for the following study areas within the Surplus OU: Janes Ravine, Hutchinson Ravine, and the Beach Area (including Lake Michigan sediments proximal to the Beach Area).

### 8.1 Risk Estimation

Estimation of potential risks for exposure pathways are presented by study area. Exposure pathways for the ravines include exposure to sediments by benthic invertebrates (*L. variegatus*); incidental ingestion of sediments by raccoons; exposure to surface water by amphibians and aquatic invertebrates; ingestion of surface water by terrestrial wildlife; and foodweb bioaccumulation exposure for raccoons ingesting *L. variegatus*.

Exposure pathways for the Beach Area include incidental ingestion of sediments by raccoons and avian species (snipe); exposure to sediments by benthic invertebrates (*H. azteca*); and foodweb bioaccumulation exposure for the raccoon and snipe by ingestion of *L. variegatus*.

Due to the limited availability of data, the only exposure pathway evaluated directly for Lake Michigan is exposure of benthic invertebrates to sediments. Fathead minnow bioassay results are presented in the evaluation of groundwater ecoCOPC toxicity for Lake Michigan surface water (groundwater discharging to lake surface water) which is evaluated as part of the Beach Area. The bioassay results represent an extreme, greater than worst case exposure.

### 8.1.1 Janes and Hutchinson Ravines

The Measurement Endpoints analyzed for Janes and Hutchinson Ravines were Endpoints 1, 2, 3, 4, 5, and 7 (Section 7.0).

Samples evaluated in the ecological risk assessment for Janes Ravine primarily consist of those samples collected from the bottom of the ravine, inclusive of sediments and surface water. Additionally, soil samples were collected from the upper slopes of Janes Ravine, which may affect resources in the ravine area. These samples were not quantitatively evaluated in the ecological risk assessment because of their nature. These soil samples were collected from drainage pipes near the upper edge of the ravine and thus, could not reasonably be combined with the sediment samples collected from the bottom of the ravine. These data were reviewed, however, and the constituents and concentrations represented in the soil samples are adequately represented by the stream sediment samples. In addition, it is expected that the stream sediments, although dynamic, represent a focused exposure to wildlife and are a focusing point for soils and/or sediments in this habitat.

**Measurement Endpoint 1--Drinking Water Benchmarks for EcoCOPCs Associated with NOAELs or LOAELs for Mortality or Reproductive Effects (if available).** EQs were calculated for shrews, feral cats, woodchucks, and racoons that may obtain drinking water from the ravines and thereby ingest surface water constituents (Table 8-1). All EQs for which appropriate ecotoxicity benchmark values were available are below one. An appropriate benchmark for sulfate was not available. Although sulfate is present in the ravines at concentrations that exceed background, the source of this sulfate is not immediately apparent. However, sulfate is a naturally-occurring constituent in aquatic systems. For general use waters, the IAC aquatic criterion is 500 mg/L. This level is not exceeded in the surface waters of either ravine. Thus, no adverse effects are anticipated for the level of sulfate observed in the ravine surface water. It should be noted that the observed concentration does exceed the IAC Lake Michigan value of 24 mg/L, and the lake is the receiving water from the ravines. However, inputs from the ravines to Lake Michigan are minimal and the contribution from the ravines would not be detectable from the normal fluctuations of sulfate levels in the lake system due to the many orders of magnitude of dilution. Thus, no adverse effects on lake resources are anticipated from the ravines' contribution. Also, no adverse effects are anticipated for terrestrial mammals obtaining drinking water from the ravine areas.

**Measurement Endpoint 2--Aquatic Ecotoxicity Benchmarks Values for EcoCOPCs (Laboratory or Field Studies) for Impairment of Amphibian Reproductive Success.** Results of the comparison of ravine surface water ecoCOPC exposure concentrations to toxicity benchmarks for amphibians is presented in Table 8-2 along with the resulting EQs. Toxicity benchmark data for amphibian species is very limited in the literature and data for several of the ecoCOPCs are unavailable. Available data were primarily restricted to pesticides and metals. Among the pesticides, DDE, DDD, and DDT are considered ecoCOPCs for the ravines. EQs for the exposure of amphibians to ecoCOPCs in Janes Ravine and Hutchinson Ravine surface water were determined. None of the EQs for the constituents exceed one, indicating no potential for adverse effects to amphibians due to exposure to pesticide concentrations present in ravine surface waters.

There has been an observed lack of amphibians in the ravines despite the absence of fish. Amphibian reproduction is sometimes adversely affected by metals in a low pH environment, but this phenomenon has not been observed in these ravines. Currently, there is no evidence that site-specific constituents are contributing to the apparently small amphibian populations in the ravines. These populations may be naturally low, despite the absence of fish, due to the highly variable nature of the surface water flows in the ravines, or may be adversely affected by physical stressors, such as erosion and scouring. This evaluation is limited by the availability of suitable ecotoxicity benchmark values for amphibian reproduction. Habitat degradation due to erosion and scouring has been observed, and may explain the apparently low levels of some organisms in the ravines. However, this cannot be quantified with available data. No baseline data are available whereby ecoCOPC effects on amphibians and other aquatic species can be evaluated, and historical anecdotal information is not sufficient to determine the prior species complement in these habitats. Therefore, specific effects due to possible ecoCOPC exposure for some constituents, especially for amphibians, cannot be fully quantified. Generalizations based upon existing ecotoxicity data were used in the evaluation and effects were estimated based upon the existing ecotoxicity data and resulting effects.

**Measurement Endpoint 3--Aquatic Invertebrate Ecotoxicity Benchmark Values for EcoCOPCs.** Results of the comparison of ravine surface water ecoCOPC exposure concentrations to toxicity benchmarks for aquatic invertebrates is presented in Table 8-3 along with the resulting EQs. All of the EQs for both ravines are less than one, indicating no potential for adverse effects to aquatic invertebrates that may reside in either Janes Ravine or Hutchinson Ravine surface water.

**Measurement Endpoint 4--Results of Site-Specific Sediment Chronic Bioassays Using Sediment from Janes and Hutchinson Ravines.** Site-specific sediment chronic bioassays using *H. azteca* were conducted using samples from both Janes and Hutchinson Ravines. The results of these studies indicate that invertebrate exposure to sediments is not chronically toxic. Therefore, no adverse effects are anticipated for sediment invertebrates exposed to ravine sediments.

**Measurement Endpoint 5--Dietary Benchmarks for Mammals Associated with NOAELs or LOAELs (if available) and Adjusted for Incidental Sediment Ingestion of EcoCOPCs.** EQs for the incidental ingestion of sediment ecoCOPCs by raccoons feeding in Janes and Hutchinson Ravines are presented in Table 8-4. EQs for both of the ravines are less than one, indicating no potential for adverse effects to raccoons ingesting sediments while feeding in the ravines.

**Measurement Endpoint 7--Dietary Benchmarks Associated with NOAELs or LOAELs (if available) and Adjusted for Ingestion of EcoCOPCs Bioaccumulated in Prey of Terrestrial Mammals, and Direct Measurement of Body Burdens in *L. variegatus*.** Evaluation of food chain bioaccumulation of constituents was performed by comparing the exposure concentrations of *L. variegatus* tissue constituents to ingestion benchmarks for the raccoon. The results of the comparison for ingestion of *L. variegatus* by raccoons feeding in Janes and Hutchinson Ravines is presented in Table 8-5. EQs for worm tissue constituents are below one, indicating no potential adverse effects for raccoons feeding in the ravine areas. Although not evaluated as sediment ecoCOPCs, cadmium, mercury, chromium, zinc, and selenium were included in the worm tissue ingestion evaluation for Janes Ravine. Similarly, selenium and zinc were evaluated for the prey ingestion pathway at Hutchinson Ravine. The evaluation for worm ingestion by raccoons was based upon the assumption that the entire diet of the raccoon would be obtained from the ravines and no additional factors were incorporated in the evaluation (i.e., home range). The inclusion of additional factors for raccoon species (i.e., home range) were not necessary given that none of the EQs exceed one. Therefore, it is not anticipated that adverse effects will result from raccoons ingesting worms in the ravine areas.

### 8.1.2 Beach Area

The Measurement Endpoints analyzed for the Beach Area were Endpoints 1, 3, 4, 5, 6, and 7 (Section 7.0).

**Measurement Endpoint 1--Drinking Water Benchmarks for EcoCOPCs Associated with NOAELs or LOAELs for Mortality or Reproductive Effects (if available).** EQs were calculated for shrews, feral cats, woodchucks, and raccoons that may obtain drinking water along the Beach Area and thereby ingest surface water constituents (Table 8-6). All EQs for which appropriate ecotoxicity benchmark values were available are below one. An appropriate benchmark for sulfate was not available. Although sulfate is present in Beach Area surface water at concentrations that exceed background, the source of this sulfate is not immediately apparent. However, sulfate is a naturally-occurring constituent in aquatic systems. For general use waters, the IAC aquatic criterion is 500 mg/L, which is greater than the observed exposure concentration. This level is not exceeded in the surface waters of the Beach Area. Thus, no adverse effects are anticipated for the level of sulfate observed in the Beach Area surface water. It should be noted that the observed concentration does exceed the IAC Lake Michigan value of 24 mg/L, and the lake is the receiving water for the Beach Area. However, inputs from the Beach Area to Lake

Michigan are minimal, and these inputs would not be detectable from the normal fluctuations of sulfate levels in the lake system due to the many orders of magnitude of dilution. Thus, no adverse effects on lake resources are anticipated. Also, no adverse effects are anticipated for terrestrial mammals obtaining drinking water from the Beach Area or Lake Michigan.

**Measurement Endpoint 3--Aquatic Ecotoxicity Benchmark Values for EcoCOPCs.** Results of the comparison of Beach Area surface water ecoCOPC exposure concentrations to toxicity benchmarks for aquatic invertebrates are presented in Table 8-7 along with the resulting EQs. Benchmark data for all ecoCOPCs were not available in the literature. EQs for the Beach Area ecoCOPCs for which benchmark data were available are less than one, indicating no potential for adverse effects to aquatic invertebrates. An ecotoxicity benchmark value was not available for sulfate, a naturally-occurring constituent in aquatic systems. For general use waters, the IAC aquatic criterion for sulfate is 500 mg/L. This level is not exceeded in the surface waters of the Beach Area, which results in an EQ less than one. Thus, no adverse effects are anticipated for the level of sulfate observed in the Beach Area surface water. It should be noted that the observed concentration does exceed the IAC Lake Michigan value of 24 mg/L, and the lake is the receiving water for the Beach Area. However, any inputs from the Beach Area to Lake Michigan are expected to be minimal, and these inputs would not be detectable from the normal fluctuations of sulfate in the lake system due to the many orders of magnitude of detection. Thus, no adverse effects on beach or lake surface water resources are anticipated.

**Measurement Endpoint 4--Results of Site-Specific Sediment Chronic Bioassays Using Sediments in the Beach Area.** Site-specific sediment chronic bioassays using *H. azteca* were conducted using samples from the Beach Area. The results of these studies indicate that invertebrate exposure to sediments is not chronically toxic. Therefore, no adverse effects are anticipated for sediment invertebrates exposed to Beach Area sediments.

**Measurement Endpoint 5--Dietary Benchmarks for Mammals Associated with NOAELs or LOAELs (if available) and Adjusted for Incidental Sediment Ingestion of ecoCOPCs.** EQs for the incidental ingestion of sediment ecoCOPCs by raccoons feeding along the Beach Area are presented in Table 8-4. EQs for most of the sediment constituents are below one. The EQs for aluminum and arsenic slightly exceed one indicating a potential for adverse effects on raccoons ingesting sediments. However, the potential for adverse effects is expected to be overestimated due to the conservative evaluation in determining benchmarks for sediment constituents. Toxicity benchmarks were determined with the assumption that the raccoons would only obtain food from the Beach Area and, thus, did not incorporate the home range of the animal into the evaluation. Most wildlife will obtain food while meandering and not strictly from one area. Consideration of the home range for the raccoon (4,157 acres) in the exposure evaluation produces EQs that are below one. Therefore, significant adverse effects from Beach Area sediment constituents are not anticipated due to incidental sediment ingestion by the raccoon.

**Measurement Endpoint 6--Dietary Benchmarks for Avian Species Associated with NOAELs or LOAELs (if available) and Adjusted for Incidental Sediment Ingestion of EcoCOPCs.** The results of the comparison of sediment exposure concentrations to benchmark data for incidental sediment ingestion by snipe at the Beach Area are presented in Table 8-8. None of the EQs exceed one, indicating no potential for adverse effects to snipe feeding along the Beach Area.

**Measurement Endpoint 7--Dietary Benchmarks Associated with NOAELs or LOAELs (if available) and Adjusted for Ingestion of EcoCOPCs Bioaccumulated in Prey of Terrestrial Mammals and Avian Species, and Direct Measurement of Body Burdens in *L. variegatus*.**

Evaluation of foodweb bioaccumulation of worm tissue constituents was performed by comparing the exposure concentrations of worm tissue constituents to ingestion benchmarks for the raccoon and the snipe. Although not evaluated as sediment ecoCOPCs, cadmium, chromium, and selenium were included in the worm tissue ingestion evaluation for the Beach Area based upon their presence in worm tissue and their potential to bioaccumulate. EQs for the ingestion of *L. variegatus* by raccoons and snipe feeding along the Beach Area are presented in Tables 8-5 and 8-9, respectively. All EQs for worm tissue ingestion by the raccoon are below one, indicating no potential adverse effects to raccoons feeding along the beach. The evaluation for worm ingestion by raccoons was based on the assumption that the entire diet of the raccoon would be obtained from the Beach Area and no additional factors were incorporated in the evaluation (i.e., home range). Based upon the EQs for this evaluation, it is not anticipated that adverse effects will result from raccoons ingesting worms along the Beach Area.

Excluding chromium and manganese, all EQs for worm tissue ingestion by the snipe are below one. The EQ for chromium is slightly greater than one (2.87) and the EQ for manganese is 82.2, indicating a potential for adverse effects on snipe feeding along the Beach Area. However, the evaluation for worm ingestion does not incorporate the home range of the snipe (approximately 72 acres), which is considerably larger than the Beach Area (approximately 8.24 acres). Taking the home range into account, there is little potential for adverse effects to snipe obtaining a portion of their diet (ingesting worms) along the Beach Area.

### 8.1.3 Littoral Zone of Lake Michigan

Measurement Endpoint 3 was used to evaluate effects that groundwater ecoCOPCs from the Surplus OU may have on Lake Michigan. Measurement Endpoint 4 was used to evaluate effects on benthic invertebrates that may live in Lake Michigan sediment.

**Measurement Endpoint 3--Site-Specific Fathead Minnow Bioassays Using Groundwater Samples.** EcoCOPCs in groundwater consist primarily of ubiquitous PAHs and some metals. Results of the site-specific bioassays with fathead minnows directly exposed to undiluted groundwater did not show any acute toxicity associated with this exposure. The groundwater that may discharge into Lake Michigan

would be diluted many orders of magnitude, and, thus, no adverse effects on lake resources are anticipated. However, it should be noted that, although no toxicity was reported for the bioassay studies, the pesticides DDT and DDD were detected in groundwater samples at concentrations that exceed the proposed Great Lakes Tier I Wildlife Criteria of 0.87 picograms per liter (pg/L). DDT and its derivatives are among the very few constituents for which such criteria have been specifically proposed, due to the effects on wildlife within the Great Lakes attributable to these constituents. Resultant concentrations in the lake water itself from the discharge of Surplus OU groundwater can be expected to be much lower. These resultant concentrations would not be expected to cause a problem in and of themselves, but contribute to the cumulative problem of DDT's adverse effects on wildlife, an identified problem in the Great Lakes.

**Measurement Endpoint 4--Sediment Ecotoxicity Benchmark Values for Benthic Invertebrates for EcoCOPCs in Lake Michigan Sediment.** The results of the comparison of sediment constituent exposure concentrations to benchmark data for benthic organisms are presented in Table 8-10. EQs for two Lake Michigan sediment ecoCOPCs, aluminum and 1,3-dinitrobenzene, slightly exceed one, indicating a potential for adverse effects to benthic invertebrates inhabiting the lake. No sediment specific toxicity benchmark data are available in the literature for these two constituents. Therefore, a benchmark value for 1,3-dinitrobenzene was developed based on an SQC value and the toxicity value for aluminum was based on a soil benchmark for invertebrates. As discussed in the RI (Volume I), 1,3-dinitrobenzene was detected in one lake sediment sample at a low concentration (just above the MDL). It is possible this explosive-related constituent is related to the burning of off-specification munitions and/or the Beach Area's history as an impact area. Evaluation of additional lake sediment samples (Appendix K) collected as part of the Department of Defense (DoD) OU RI determined that no additional detections of 1,3-dinitrobenzene were reported for Lake Michigan sediment samples. The fact that only one detection of 1,3-dinitrobenzene has been reported in the beach/lake sediment samples and this detection is just above the MDL, suggests that this detection may be anomalous. Given that the occurrence of 1,3-dinitrobenzene in Lake Michigan sediments appears limited to one location at the Surplus OU and that this detection of 1,3-dinitrobenzene appears to be anomalous, significant adverse effects to the aquatic community are not anticipated.

Statistical analyses of sediment samples collected as part of the DoD OU RI indicate that the aluminum concentrations detected in the Beach Area Lake Michigan sediment samples are at the low end of the range of aluminum concentrations detected in all lake sediment samples (see Appendix K). Twenty sediment samples were collected from Lake Michigan as part of the DoD OU RI. Summary statistics of sediment sample aluminum concentrations are presented in Table 1 of Appendix K. The aluminum concentrations of the Beach Area sediment samples (TRSD01 and TRSD02) are at the low end of the range of aluminum concentrations of the combined Beach Area/DoD OU sediment samples. Aluminum concentrations are 1,450 and 1,430 micrograms per gram ( $\mu\text{g/g}$ ) in Samples TRSD01 and TRSD02,

respectively (Table 2 Appendix K; note that the table also includes the values measured in duplicate samples). Aluminum concentrations detected in the DoD OU RI sediment samples ranged from 1,450 to 3,100  $\mu\text{g/g}$ . Considering the entire Fort Sheridan beach and lake area, it appears that effects of benthic invertebrates due to aluminum exposure concentrations in the Beach Area lake sediments are minimal when compared to aluminum concentrations elsewhere in the lake.

## 8.2 Ecological Significance of Risk

Based on the results described in Section 8.1.1, site-specific bioassays indicated no chronic toxicity to the benthic species *H. azteca* and *L. variegatus* following exposure to sediments from Janes and Hutchinson Ravines. Incidental ingestion of sediment ecoCOPCs from both ravines does not pose a threat to raccoons. Ingestion of ecoCOPCs contained in surface water at the ravines does not pose a threat due to ingestion by mammals such as shrews, feral cats, woodchucks, and raccoons. The results in Section 8.1.1 indicate that exposure to ecoCOPCs in surface water located in the ravines does not pose a threat to amphibians or aquatic invertebrates. Field surveys have noted that amphibian populations are smaller than might be expected in the ravine habitat given that fish are not present. This assessment concludes that exposure of ecoCOPCs to juvenile amphibians in ravine surface waters does not explain why these populations are small. There is also little potential for adverse effects on raccoons ingesting *L. variegatus* using ravine sediments as a substrate.

Based on the results described in Section 8.1.2, site-specific bioassays indicated no chronic toxicity to the benthic species *L. variegatus* following exposure to sediments from the Beach Area. Results for the scenario of raccoons ingesting beach sediment indicated a potential for adverse effects due to two ecoCOPCs, aluminum and arsenic. However, the evaluation did not incorporate the home range of the receptor species, which would minimize any adverse effects. Ingestion of ecoCOPCs in sediment does not pose a threat to snipe in the Beach Area. The results in Section 8.1.2 indicate that ecoCOPCs in surface water do not pose a threat to shrews, feral cats, woodchucks, and raccoons ingesting surface water from the Beach Area or lake. Analyses of the potential ingestion of *L. variegatus* using the Beach Area sediment as a substrate by the Common snipe indicate that there are two ecoCOPCs (chromium and manganese) that could cause adverse effects to the species. The evaluation did not incorporate the home range of the snipe, which would minimize any potential for adverse effects.

Based on the results described in Section 8.1.4, two ecoCOPCs detected in sediment from Lake Michigan could potentially cause adverse effects to benthic invertebrate species. The ecoCOPCs of concern are aluminum and 1,3-dinitrobenzene. Due to the small sample size and limited data for the Surplus OU, it is not possible to determine on the basis of these data alone if the ecoCOPCs are actually site-related or if any in-situ adverse effects could be expected. However, the evaluation of additional lake sediment sample data collected as part of the DoD OU RI showed no detections of 1,3-dinitrobenzene. In addition,



aluminum concentrations detected in Surplus OU lake sediment samples are less than those detected in the DoD OU RI Lake Michigan sediment samples. Undiluted and direct input media from the site to Lake Michigan have been directly evaluated. These include surface waters and sediments from the ravines and Beach Area, as well as groundwater. The site-specific bioassays indicated no acute toxicity to the fathead minnow following exposure to groundwater. These evaluations concluded that these media, by whatever exposure pathway, do not pose a significant potential for adverse effects to ecological receptors.

### **Results of Combined Pathway Risk Evaluation**

Some receptors may be potentially exposed to ecoCOPCs by multiple exposure pathways and/or in multiple study areas. Both the raccoon and the snipe were evaluated for multiple exposure

As presented in Table 8-11, the combined sediment and worm EQs for total chromium and manganese for snipe feeding along the Beach Area exceed 1. It is also apparent that the exceedance is the result of the ingestion of worms. This scenario is conservative and assumes that the snipe is obtaining 100 percent of its prey from the 8.24 acre Beach Area. Snipe, however, have an average home range of 72 acres. Therefore, the Beach Area represents only 11 percent of an average snipe home range. Assuming that only 11 percent of snipe feeding occurs at the Beach Area would reduce the EQs for total chromium and manganese to 0.33 and 9.4, respectively. This analysis indicates that manganese may represent a potential problem for snipe feeding at the Beach Area, but that chromium would not. However, concentrations of manganese in prey from the Beach Area (2.69 mg/kg; see Table 8-9) appear similar to background concentrations in prey (2.16 mg/kg; see Table 5-23, Volume I). Therefore, this exposure may be a naturally occurring phenomenon.

As presented in Table 8-12, the combined media intake of ecoCOPCs for either Hutchinson Ravine or Janes Ravine do not pose risks for the raccoon. However, for the raccoon feeding and drinking along the Beach Area, the total EQs for aluminum and arsenic are greater than 1. The total EQs result primarily from the incidental ingestion of Beach Area sediments. This evaluation is conservative and assumes that 100 percent of the incidental ingestion of sediments by raccoons is from the Beach Area. The average home range of a raccoon is 4,157 acres. Each ravine is approximately 19.5 acres and the Beach Area is 8.24 acres. The ravines each represent only 0.5 percent of a raccoon's home range and the Beach Area represents only 0.2 percent of a raccoon's home range. The three study areas combined represent only 1.2 percent of a raccoon's home range. Assuming that only 1.2 percent of incidental sediment ingestion by raccoon occurs at the ravines and Beach Area would reduce the total EQs for aluminum and arsenic to 0.05 and 0.02, respectively. Consideration of the home range of the raccoon indicates that cumulative exposure to any ecoCOPC for any medium present at the ravines and Beach Area study areas does not pose a risk for ecological receptors.

### 8.3 Uncertainties Associated with the Ecological Risk Assessment

The derivation of ecological EQs for different constituents and different indicator species was conducted using laboratory toxicity data that were available in the literature. A considerable amount of uncertainty associated with inter- and intraspecies extrapolation exists when determining benchmark data. The preferred benchmark value that was sought was a chronic LOAEL dose. When there was no chronic LOAEL value available for a constituent in the literature, other values such as LD<sub>50</sub> were used or, as in the case of sulfate, an IAC screening criteria was used in the evaluation for aquatic effects, which includes additional uncertainty. Additionally, uncertainty exists when a soil toxicity value was used for sediment media as with Lake Michigan sediment ecoCOPCs. An uncertainty also exists for estimation of exposure when exposure concentrations are based upon a small sample size that may not adequately reflect the presence of ecoCOPCs at the site. For example, the data available for the Lake Michigan littoral zone was relatively small (only two sediment samples). The use of Lake Michigan sediment sample data from the DoD OU RI was used to augment the validity of the exposure evaluation. Additional consideration for uncertainty must be given when using data collected and evaluated for other OUs. Additionally, assumptions must be made regarding actual exposure. Little is known about the potentially synergistic or additive toxicological effects of ecoCOPCs in mixtures. The potential for such effects cannot be evaluated in this risk assessment. To balance such uncertainties, assumptions tend to be conservative, which will over estimate rather than underestimate risks. In addition, site-specific studies and data decrease the need to rely on literature toxicity information, and increase confidence in risk estimation and conclusions. Bioassay tests include a certain degree of uncertainty, such as the possible degradation of toxicants in the site samples during shipment to the laboratory. Uncertainties in the bioassay tests were decreased by minimizing the holding times for the samples, conducting reference toxicant tests, and replicating each test exposure concentration.

Table 8-1. Ecotoxicity Quotients for Evaluation of Surface Water EcoCOPC Ingestion by Four Terrestrial Species at Janes and Hutchinson Ravines (Page 1 of 2)

Study Area	EcoCOPC	Endpoint Species	Benchmark (mg/L)	Exposure Concentration (mg/L)	Ecotoxicity Quotient (Unitless)	Does Ecotoxicity Quotient Exceed One?
Janes Ravine	DDD, p,p'-	Shrew	5.20E+01	1.55E-05	2.99E-07	No
		Feral Cat	4.47E+01	1.55E-05	3.47E-07	No
		Woodchuck	2.09E+01	1.55E-05	7.43E-07	No
		Raccoon	1.86E+01	1.55E-05	8.35E-07	No
	DDT, p,p'-	Shrew	5.20E+01	1.10E-05	2.12E-07	No
		Feral Cat	4.47E+01	1.10E-05	2.46E-07	No
		Woodchuck	2.09E+01	1.10E-05	5.27E-07	No
		Raccoon	1.86E+01	1.10E-05	5.92E-07	No
	Manganese	Shrew	3.69E+03	2.00E-01	5.43E-05	No
		Feral Cat	3.18E+03	2.00E-01	6.30E-05	No
		Woodchuck	1.48E+03	2.00E-01	1.35E-04	No
		Raccoon	1.32E+03	2.00E-01	1.52E-04	No
	Sulfate	Shrew	—	1.61E+02	—	NE
		Feral Cat	—	1.61E+02	—	NE
		Woodchuck	—	1.61E+02	—	NE
		Raccoon	—	1.61E+02	—	NE
Hutchinson Ravine	Anthracene	Shrew	1.30E+04	8.91E-04	6.86E-08	No
		Feral Cat	1.12E+04	8.91E-04	7.97E-08	No
		Woodchuck	5.22E+03	8.91E-04	1.71E-07	No
		Raccoon	4.64E+03	8.91E-04	1.92E-07	No
	Benzo(a)pyrene	Shrew	5.73E+01	1.11E-05	1.93E-07	No
		Feral Cat	4.93E+01	1.11E-05	2.25E-07	No
		Woodchuck	2.30E+01	1.11E-05	4.82E-07	No
		Raccoon	2.05E+01	1.11E-05	5.41E-07	No
	Cyanide, total	Shrew	8.21E+02	2.20E-03	2.68E-06	No
		Feral Cat	7.07E+02	2.20E-03	3.11E-06	No
		Woodchuck	3.30E+02	2.20E-03	6.67E-06	No
		Raccoon	2.94E+02	2.20E-03	7.49E-06	No
	DDD, p,p'-	Shrew	5.20E+01	6.35E-05	1.22E-06	No
		Feral Cat	4.47E+01	6.35E-05	1.42E-06	No
		Woodchuck	2.09E+01	6.35E-05	3.04E-06	No
		Raccoon	1.86E+01	6.35E-05	3.42E-06	No
	DDE, p,p'-	Shrew	5.20E+01	5.67E-06	1.09E-07	No
		Feral Cat	4.47E+01	5.67E-06	1.27E-07	No
		Woodchuck	2.09E+01	5.67E-06	2.72E-07	No
		Raccoon	1.86E+01	5.67E-06	3.05E-07	No

Table 8-1. Ecotoxicity Quotients for Evaluation of Surface Water EcoCOPC Ingestion by Four Terrestrial Species at Janes and Hutchinson Ravines (Page 2 of 2)

Study Area	EcoCOPC	Endpoint Species	Benchmark (mg/L)	Exposure Concentration (mg/L)	Ecotoxicity Quotient (Unitless)	Does Ecotoxicity Quotient Exceed One?
	DDT, p,p'-	Shrew	5.20E+01	1.00E-05	1.92E-07	No
		Feral Cat	4.48E+01	1.00E-05	2.23E-07	No
		Woodchuck	2.09E+01	1.00E-05	4.79E-07	No
		Raccoon	1.86E+01	1.00E-05	5.38E-07	No
	Decachlorobiphenyl	Shrew	3.25E+01	3.30E-04	1.02E-05	No
		Feral Cat	2.80E+01	3.30E-04	1.18E-05	No
		Woodchuck	1.30E+01	3.30E-04	2.53E-05	No
		Raccoon	1.16E+01	3.30E-04	2.84E-05	No
	Manganese	Shrew	3.69E+03	8.91E-01	2.42E-04	No
		Feral Cat	3.18E+03	8.91E-01	2.80E-04	No
		Woodchuck	1.48E+03	8.91E-01	6.02E-04	No
		Raccoon	1.32E+03	8.91E-01	6.76E-04	No
	Pyrene	Shrew	5.73E+01	1.94E-04	3.39E-06	No
		Feral Cat	4.93E+01	1.94E-04	3.93E-06	No
		Woodchuck	2.30E+01	1.94E-04	8.44E-06	No
		Raccoon	2.05E+01	1.94E-04	9.48E-06	No
	Sulfate	Shrew	—	1.55E+02	—	NE
		Feral Cat	—	1.55E+02	—	NE
		Woodchuck	—	1.55E+02	—	NE
		Raccoon	—	1.55E+02	—	NE

— = Not available in literature

COPC = constituent of potential concern

mg/L = milligrams per liter

NE = Not evaluated due to lack of benchmark data

Source: QST, 1998.

Table 8-2. Ecotoxicity Quotients for Evaluation of Surface Water EcoCOPC Exposure for Amphibians at Janes and Hutchinson Ravines

Study Area	EcoCOPC	Benchmark (mg/L)	Exposure Concentration (mg/L)	Ecotoxicity Quotient	Does Ecotoxicity Quotient Exceed One?
Janes Ravine	DDD, p,p'-	8.70E-03	1.55E-05	1.78E-03	No
	DDT, p,p'-	8.70E-03	1.10E-05	1.26E-03	No
	Manganese	--	2.00E-01	--	NE
	Sulfate	--	1.61E+02	--	NE
Hutchinson Ravine	DDD, p,p'-	8.70E-03	6.35E-05	7.30E-03	No
	DDE, p,p'-	8.70E-03	5.67E-06	6.52E-04	No
	DDT, p,p'-	8.70E-03	1.00E-05	1.15E-03	No
	Anthracene	--	8.91E-04	--	NE
	Benzo(a)pyrene	--	1.11E-05	--	NE
	Cyanide, total	--	2.20E-03	--	NE
	Decachlorobiphenyl	--	3.30E-04	--	NE
	Manganese	--	8.91E-01	--	NE
	Pyrene	--	1.94E-04	--	NE
	Sulfate	--	1.55E+02	--	NE

COPC = constituent of potential concern

mg/L = milligrams per liter

NE -- Not evaluated due to lack of benchmark data

Source: QST, 1998.

Table 8-3. Ecotoxicity Quotients for Evaluation of Surface Water EcoCOPC Exposure for Aquatic Invertebrates at Janes and Hutchinson Ravines

Study Area	EcoCOPC	Benchmark (mg/L)	Exposure Concentration (mg/L)	Ecotoxicity Quotient (Unitless)	Does Ecotoxicity Quotient Exceed One?
Janes Ravine	DDD, p,p'-	3.20E-03	1.55E-05	4.85E-03	No
	DDT, p,p'-	1.60E-05	1.10E-05	6.88E-01	No
	Manganese	1.10E+00	2.00E-01	1.82E-01	No
	Sulfate	5.00E+02	1.61E+02	3.22E-01	No
Hutchinson Ravine	Anthracene	2.10E-03	8.91E-04	4.24E-01	No
	Benzo(a)pyrene	3.00E-04	1.11E-05	3.69E-02	No
	Cyanide, total	1.83E-02	2.20E-03	1.20E-01	No
	DDD, p,p'-	3.20E-03	6.35E-05	1.98E-02	No
	DDE, p,p'-	1.60E-05	5.67E-06	3.55E-01	No
	DDT, p,p'-	1.60E-05	1.00E-05	6.25E-01	No
	Decachlorobi-phenyl	2.10E-03	3.30E-04	1.57E-01	No
	Manganese	1.10E+00	8.91E-01	8.10E-01	No
	Pyrene	3.00E-04	1.94E-04	6.47E-01	No
	Sulfate	5.00E+02	1.55E+02	3.1E-01	No

-- = Not available in literature

COPC = constituent of potential concern

mg/L = milligrams per liter

NE -- Not evaluated due to lack of benchmark data

Source: QST, 1998.

Table 8-4. Ecotoxicity Quotients for Evaluation of Sediment Ingestion by Raccoons at Janes and Hutchinson Ravines and the Beach Area (Page 1 of 2)

Study Area	EcoCOPC	Ingestion Benchmark (mg/kg)	Exposure Concentration (mg/kg)	Ecotoxicity Quotient (Unitless)	Does Ecotoxicity Quotient Exceed One?
Janes Ravine	Chlordane, total	3.36E+02	5.20E+00	1.55E-02	No
	DDD, p,p'-	3.32E+02	6.60E+00	1.99E-02	No
	DDE, p,p'-	3.32E+02	4.80E-01	1.45E-03	No
	DDT, p,p'-	3.32E+02	5.90E+00	1.78E-02	No
	Hexachlorocyclohexane, gamma- (Lindane)	6.63E+02	7.10E-02	1.07E-04	No
	Methoxychlor	6.63E+02	1.06E-01	1.60E-04	No
	Methylnaphthalene, 2-Silver	4.15E+03	2.17E-01	5.24E-05	No
Hutchinson Ravine		8.39E+03	5.69E-01	6.78E-05	No
	2,4,5-T	8.29E+02	1.89E-02	2.28E-05	No
	Acenaphthene	6.40E+03	2.45E+00	3.83E-04	No
	Acenaphthylene	3.66E+02	1.39E+00	3.79E-03	No
	Aldrin	8.29E+01	1.63E-02	1.96E-04	No
	Anthracene	3.66E+04	7.00E+00	1.92E-04	No
	Benz(a)anthracene	4.86E+02	1.00E+01	2.06E-02	No
	Benzo(a)pyrene	3.66E+02	8.00E+00	2.19E-02	No
	Benzo(b)fluoranthene	4.86E+02	8.00E+00	1.65E-02	No
	Benzo(g,h,i)perylene	4.86E+02	2.74E+00	5.64E-03	No
	Benzo(k)fluoranthene	3.66E+02	5.00E+00	1.37E-02	No
	Cadmium	8.29E+02	3.31E-01	3.99E-04	No
	Carbazole	3.66E+02	1.53E+00	4.19E-03	No
	Chlordane, alpha-	3.36E+02	2.43E-02	7.22E-05	No
	Chlordane, gamma-	3.36E+02	2.96E-02	8.81E-05	No
	Chlordane, total	3.36E+02	7.65E-01	2.27E-03	No
	Chrysene	4.86E+02	1.00E+01	2.06E-02	No
	Cyanide, total	5.24E+03	3.32E-01	6.33E-05	No
	DDD, p,p'-	3.32E+02	1.00E+01	3.01E-02	No
	DDE, p,p'-	3.32E+02	2.92E-01	8.82E-04	No
	DDT, p,p'-	3.32E+02	5.00E-01	1.51E-03	No
	Dibenzo(a,h)anthracene	4.86E+02	2.70E-01	5.55E-04	No
	Endrin	3.36E+01	1.09E-02	3.25E-04	No
	Fluoranthene	1.83E+04	3.00E+01	1.64E-03	No
	Fluorene	4.57E+03	3.49E+00	7.64E-04	No
	Hexachlorocyclohexane, gamma- (Lindane)	6.63E+02	3.38E-03	5.10E-06	No
	Indeno(1,2,3-cd)pyrene	4.86E+02	4.00E+00	8.23E-03	No
	Mercury	1.18E+02	9.71E-02	8.25E-04	No
	Methylnaphthalene, 2-	4.15E+03	3.70E+00	8.91E-04	No
	Naphthalene	4.15E+03	2.31E+00	5.57E-04	No
	Phenanthrene	3.66E+02	3.00E+01	8.21E-02	No
	Pyrene	3.66E+02	2.00E+01	5.47E-02	No
	Silver	8.39E+03	6.14E-01	7.32E-05	No

Table 8-4. Ecotoxicity Quotients for Evaluation of Sediment Ingestion by Raccoons at Janes and Hutchinson Ravines and the Beach Area (Page 2 of 2)

Study Area	EcoCOPC	Ingestion Benchmark (mg/kg)	Exposure Concentration (mg/kg)	Ecotoxicity Quotient (Unitless)	Does Ecotoxicity Quotient Exceed One?
Beach Area	Aluminum	7.06E+02	3.10E+03	4.39E+00	Yes
	Antimony	4.57E+01	8.68E+00	1.90E-01	No
	Arsenic	4.61E+00	7.63E+00	1.66E+00	Yes
	Chlordane, total	3.36E+02	1.18E-01	3.51E-04	No
	DDD, p,p'-	3.32E+02	2.53E-01	7.64E-04	No
	DDE, p,p'-	3.32E+02	3.50E-02	1.06E-04	No
	DDT, p,p'-	3.32E+02	9.80E-02	2.96E-04	No
	Hexachlorocyclohexane, gamma- (Lindane)	6.63E+02	1.99E-02	3.00E-05	No
	Manganese	2.35E+04	5.00E+02	2.12E-02	No
	Nickel	6.63E+03	1.30E+01	1.96E-03	No
	Zinc	2.65E+04	6.84E+01	2.58E-03	No

COPC = constituent of potential concern

mg/kg = milligrams per kilogram

Source: QST, 1998.



Table 8-5 Ecotoxicity Quotients for Ingestion of EcoCOPCs in *L. variegatus* by Raccoons at the Ravine and Beach Areas

Study Area	EcoCOPC	Exposure Concentration (mg/kg)	Benchmark (mg/kg)	Ecotoxicity Quotient	Does Exposure Concentration Exceed One?
Janes Ravine	Cadmium	8.26E-02	1.06E+03	7.83E-05	No
	Chromium, total	2.17E-01	1.39E+03	1.56E-04	No
	DDD, p,p'-	8.00E-02	4.22E+02	1.90E-04	No
	DDE, p,p'-	3.40E-02	4.22E+02	8.05E-05	No
	DDT, p,p'-	2.40E-03	4.22E+02	5.69E-06	No
	Mercury	1.49E-02	1.50E+02	9.95E-05	No
	Selenium	2.86E-01	3.54E+01	8.09E-03	No
	Silver	1.03E-02	1.07E+04	9.64E-07	No
	Zinc	4.46E+01	3.38E+04	1.32E-03	No
Hutchinson Ravine	Aldrin	1.90E-03	1.06E+02	1.80E-05	No
	Cadmium	3.72E-02	1.06E+03	3.52E-05	No
	Chlordane, alpha-	3.60E-03	4.28E+02	5.41E-06	No
	Chlordane, gamma-	5.50E-03	4.28E+02	1.28E-05	No
	DDD, p,p'-	3.80E-01	4.22E+02	9.00E-04	No
	DDE, p,p'-	9.60E-02	4.22E+02	2.27E-04	No
	DDT, p,p'-	2.30E-03	4.22E+02	5.45E-06	No
	Mercury	1.09E-02	1.50E+02	7.28E-05	No
	Selenium	3.18E-01	3.54E+01	8.99E-03	No
	Silver	1.17E-02	1.07E+04	1.10E-06	No
	Zinc	4.83E+01	3.38E+04	1.43E-03	No
Beach Area	Aluminum	2.52E+01	8.98E+02	2.81E-02	No
	Arsenic	2.52E-01	5.86E+00	4.30E-02	No
	Cadmium	3.77E-02	1.06E+03	3.57E-05	No
	Chromium, total	9.40E-02	1.39E+03	6.78E-05	No
	DDD, p,p'-	6.40E-02	4.22E+02	1.52E-04	No
	DDE, p,p'-	1.20E-02	4.22E+02	2.84E-05	No
	DDT, p,p'-	3.30E-03	4.22E+02	7.82E-06	No
	Manganese	2.69E+00	3.00E+04	8.97E-05	No
	Nickel	4.80E-01	8.44E+03	5.69E-05	No
	Selenium	3.27E-01	3.54E+01	9.25E-03	No
	Zinc	5.17E+01	3.38E+04	1.53E-03	No

COPC = constituent of potential concern

mg/kg = milligrams per kilogram

Source: QST, 1998.

Table 8-6. Ecotoxicity Quotients for Ingestion of Surface Water EcoCOPCs by Terrestrial Mammals at the Beach Area

Study Area	EcoCOPC	Endpoint Species	Benchmark (mg/L)	Exposure Concentration (mg/L)	Ecotoxicity Quotient (Unitless)	Does Exposure Concentration Exceed One?
Beach Area	Barium	Shrew	7.12E+01	4.20E-02	5.90E-04	No
		Feral Cat	6.13E+01	4.20E-02	6.85E-04	No
		Woodchuck	2.86E+01	4.20E-02	1.47E-03	No
		Raccoon	2.55E+01	4.20E-02	1.65E-03	No
	Manganese	Shrew	3.69E+03	2.76E-01	7.47E-05	No
		Feral Cat	3.18E+03	2.76E-01	8.68E-05	No
		Woodchuck	1.48E+03	2.76E-01	1.86E-04	No
		Raccoon	1.32E+03	2.76E-01	2.09E-04	No
	Sulfate	Shrew	--	2.48E+02	NE	NE
		Feral Cat	--	2.48E+02	NE	NE
		Woodchuck	--	2.48E+02	NE	NE
		Raccoon	--	2.48E+02	NE	NE

-- = Not available in literature

COPC = constituent of potential concern

mg/L = milligrams per liter

NE = Not evaluated due to lack of benchmark data

Source: QST, 1998.

Table 8-7. Ecotoxicity Quotients for Evaluation of Aquatic Invertebrate Exposure to Surface Water EcoCOPCs at the Beach Area

Study Area	EcoCOPC	Benchmark (mg/L)	Exposure Concentration (mg/L)	Ecotoxicity Quotient (Unitless)	Does Ecotoxicity Quotient Exceed One?
Beach Area	Barium	5.80E+00	4.20E-02	7.24E-03	No
	Manganese	1.10E+00	2.76E-01	2.51E-01	No
	Sulfate	5.00E+02	2.48E+02	4.96E-01	No

COPC = constituent of potential concern

mg/L = milligrams per liter

Source: QST, 1998.

Table 8-8 Ecotoxicity Quotients for Evaluation of Sediment EcoCOPC Ingestion by Common Snipe at the Beach Area

Study Area	EcoCOPC	Endpoint Species	Ingestion Benchmark (mg/kg)	Exposure Concentration (mg/kg)	Ecotoxicity Quotient (Unitless)	Does Ecotoxicity Quotient Exceed One?
Beach Area	Aluminum	Common Snipe	7.93E+03	3.10E+03	3.91E-01	No
	Antimony	Common Snipe	4.55E+01	8.68E+00	1.91E-01	No
	Arsenic	Common Snipe	1.21E+02	7.63E+00	6.30E-02	Yes
	Chlordane, total	Common Snipe	1.15E+02	1.18E-01	1.02E-03	Yes
	Hexachlorocyclohexane, gamma- (Lindane)	Common Snipe	2.69E+02	1.99E-02	7.39E-05	No
	Manganese	Common Snipe	5.47E+04	5.00E+02	9.14E-03	No
	Nickel	Common Snipe	9.60E+03	1.30E+01	1.35E-03	No
	DDD, p,p'-	Common Snipe	5.72E+00	2.53E-01	4.43E-02	No
	DDE, p,p'-	Common Snipe	5.72E+00	3.50E-02	6.12E-03	No
	DDT, p,p'-	Common Snipe	5.72E+00	9.80E-02	1.71E-02	Yes
	Zinc	Common Snipe	2.43E+03	6.84E+01	2.81E-02	Yes

COPC = constituent of potential concern  
 mg/kg = milligrams per kilogram

Source: QST, 1998.

Table 8-9 Ecotoxicity Quotients for Evaluation of Ingestion of EcoCOPCs in *L. variegatus* by Snipes at the Beach Area

Study Area	EcoCOPC	Exposure Concentration (mg/kg)	Benchmark (mg/kg)	Ecotoxicity Quotient (Unitless)	Does Ecotoxicity Quotient Exceed One?
Beach Area	Aluminum	2.52E+01	1.22E+03	2.07E-02	No
	Arsenic	2.52E-01	1.86E+01	1.36E-02	No
	Cadmium	3.77E-02	3.15E+01	1.20E-03	No
	DDD, p,p'-	6.40E-02	8.78E-01	7.29E-02	No
	DDE, p,p'-	1.20E-02	8.78E-01	1.37E-02	No
	DDT, p,p'-	3.30E-03	8.78E-01	3.76E-03	No
	Nickel	4.80E-01	1.47E+03	3.26E-04	No
	Selenium	3.27E-01	1.09E+01	3.01E-02	No
	Zinc	5.17E+01	3.73E+02	1.39E-01	No
	Chromium, total	9.40E-02	3.27E-02	2.87E+00	Yes
	Manganese	2.69E+00	3.27E-02	8.22E+01	Yes

COPC = constituent of potential concern

mg/kg = milligrams per kilogram

Source: QST, 1998.

Table 8-10. Ecotoxicity Quotients for Evaluation of Sediment EcoCOPC Exposure for Benthic Invertebrates in Lake Michigan

Study Area	EcoCOPC	Ecotoxicity Benchmark (mg/kg)	Exposure Concentration (mg/kg)	Ecotoxicity Quotient (Unitless)	Does Ecotoxicity Quotient Exceed One?
Lake Michigan	Aluminum	1.00E+03	1.45E+03	1.45E+00	Yes
	Dinitrobenzene, 1,3-	1.91E-01	2.97E-01	1.55E+00	Yes

COPC = constituent of potential concern

mg/kg = milligrams per kilogram

Source: QST, 1998.

Table 8-11. Total Ecotoxicity Quotients for Snipe at the Beach Area

COPC	Ecotoxicity Quotient (EQ)			Total EQ Exceed 1?
	Sediment	Worm	Total	
Aluminum	3.91E-01	2.07E-02	4.12E-01	No
Antimony	1.91E-01	--	1.91E-01	No
Arsenic	6.30E-02	1.36E-02	7.65E-02	No
Cadmium	--	1.20E-03	1.20E-03	No
Chlordane, total	1.02E-03	--	1.02E-03	No
Chromium, total	--	2.87E+00	2.87E+00	Yes
DDD, p,p'-	4.43E-02	7.29E-02	1.17E-01	No
DDE, p,p'-	6.12E-03	1.37E-02	1.98E-02	No
DDT, p,p'-	1.71E-02	3.76E-03	2.09E-02	No
Hexachlorocyclohexane, gamma-	7.39E-05	--	7.39E-05	No
Manganese	9.14E-03	8.22E+01	8.22E+01	Yes
Nickel	1.35E-03	3.26E-04	1.68E-03	No
Selenium	--	3.01E-02	3.01E-02	No
Zinc	2.81E-02	1.39E-01	1.67E-01	No

-- = Not evaluated as a ecoCOPC in specific media.

COPC = constituent of potential concern

Source: QST, 1998.

Table 8-12. Total Ecotoxicity Quotients for Raccoons in Janes Ravine, Hutchinson Ravine, and the Beach Area (1 of 2)

Study Area/COPC	Ecotoxicity Quotient (EQ)				Total EQ Exceed 1?
	Sediment	Surface Water	Worm	Total	
Janes Ravine					
Cadmium	—	—	7.83E-05	7.83E-05	No
Chlordane, total	1.55E-02	—	—	1.55E-02	No
Chromium, total	—	—	1.56E-04	1.56E-04	No
DDD, p,p'-	1.99E-02	8.35E-07	1.90E-04	2.01E-02	No
DDE, p,p'-	1.45E-03	—	8.05E-05	1.53E-03	No
DDT, p,p'-	1.78E-02	5.92E-07	5.69E-06	1.78E-02	No
Hexachlorocyclohexane, gamma-	1.07E-04	—	—	1.07E-04	No
Manganese	—	1.52E-04	—	1.52E-04	No
Mercury	—	—	9.95E-05	9.95E-05	No
Methoxychlor	1.60E-04	—	—	1.60E-04	No
Methylnaphthalene, 2-	5.24E-05	—	—	5.24E-05	No
Selenium	—	—	8.09E-03	8.09E-03	No
Silver	6.78E-05	—	9.64E-07	6.87E-05	No
Sulfate	—	—	—	—	No
Zinc	—	—	1.32E-03	1.32E-03	No
Hutchinson Ravine					
2,4,5-T	2.28E-05	—	—	2.28E-05	No
Acenaphthene	3.83E-04	—	—	3.83E-04	No
Acenaphthylene	3.81E-03	—	—	—	No
Aldrin	1.96E-04	—	1.80E-05	3.81E-03	No
Anthracene	1.91E-04	1.92E-07	—	1.92E-04	No
Benzo(a)anthracene	2.06E-02	—	—	2.06E-02	No
Benzo(a)pyrene	2.19E-02	5.41E-07	—	2.19E-02	No
Benzo(b)fluoranthene	1.65E-02	—	—	1.65E-02	No
Benzo(g,h,i)perylene	5.64E-03	—	—	5.64E-03	No
Benzo(k)fluoranthene	1.37E-02	—	—	1.37E-02	No
Cadmium	3.99E-04	—	3.52E-05	4.35E-04	No
Carbazole	4.19E-03	—	—	4.19E-03	No
Chlordane, alpha-	7.22E-05	—	8.41E-06	8.06E-05	No
Chlordane, gamma-	8.81E-05	—	1.28E-05	1.01E-04	No
Chlordane, total	2.27E-03	—	—	2.27E-03	No
Chrysene	2.06E-02	—	—	2.06E-02	No
Cyanide, total	6.33E-05	7.49E-06	—	7.08E-05	No
DDD, p,p'-	3.01E-02	3.42E-06	9.00E-04	3.11E-02	No
DDE, p,p'-	8.82E-04	3.05E-07	2.27E-04	1.11E-03	No
DDT, p,p'-	1.51E-03	5.38E-07	5.45E-06	1.51E-03	No
Decachlorobiphenyl	—	2.84E-05	—	2.84E-05	No



Table 8-12. Total Ecotoxicity Quotients for Raccoons in Janes Ravine, Hutchinson Ravine, and the Beach Area (2 of 2)

Study Area/COPC	Ecotoxicity Quotient (EQ)				Total EQ Exceed 1?
	Sediment	Surface Water	Worm	Total	
Dibenzo(a,h)anthracene	5.55E-04	--	--	5.55E-04	No
Endrin	3.25E-04	--	--	3.25E-04	No
Fluoranthene	1.64E-03	--	--	1.64E-03	No
Fluorene	7.64E-04	--	--	7.64E-04	No
Hexachlorocyclohexane, gamma-	5.10E-06	--	--	5.10E-06	No
Indeno(1,2,3-cd)pyrene	8.23E-03	--	--	8.23E-03	No
Manganese	--	6.76E-04	--	6.76E-04	No
Mercury	8.25E-04	--	7.28E-05	8.98E-04	No
Methylnaphthalene, 2-	8.91E-04	--	--	8.91E-04	No
Naphthalene	5.57E-04	--	--	5.57E-04	No
Phenanthrene	8.21E-02	--	--	8.21E-02	No
Pyrene	5.47E-02	9.48E-06	--	5.47E-02	No
Selenium	--	--	8.99E-03	8.99E-03	No
Silver	7.32E-05	--	1.10E-06	7.43E-05	No
Sulfate	--	--	--	--	No
Zinc	--	--	1.43E-03	1.43E-03	No
<b>Beach Area</b>					
Aluminum	4.39E+00	--	2.81E-02	4.42E+00	Yes
Antimony	1.90E-01	--	--	1.90E-01	No
Arsenic	1.66E+00	--	4.30E-02	1.70E+00	Yes
Barium	--	1.65E-03	--	1.65E-03	No
Cadmium	--	--	3.57E-05	3.57E-05	No
Chlordane, total	3.51E-04	--	--	3.51E-04	No
Chromium, total	--	--	6.78E-05	6.78E-05	No
DDD, p,p'-	7.64E-04	--	1.52E-04	9.16E-04	No
DDE, p,p'-	1.06E-04	--	2.84E-05	1.34E-04	No
DDT, p,p'-	2.95E-04	--	7.82E-06	3.03E-04	No
Hexachlorocyclohexane, gamma-	3.00E-05	--	--	3.00E-05	No
Manganese	2.12E-02	2.09E-04	8.97E-05	2.15E-02	No
Nickel	1.96E-03	--	5.69E-05	2.01E-03	No
Selenium	--	--	9.25E-03	9.25E-03	No
Sulfate	--	--	--	--	No
Zinc	2.58E-03	--	1.53E-03	4.11E-03	No

-- = Not evaluated as an ecoCOPC in specific media.

COPC = constituent of potential concern

Source: QST, 1998.

**This page left blank intentionally**

## 9.0 Conclusions

Outlined below are specific conclusions for the Surplus OU based on the results of the BRA. The detailed results of the human health risk analysis (i.e., data evaluation, exposure assessment, toxicity assessment, and risk characterization) are presented in Sections 2.0, 3.0, 4.0, and 5.0, and are not duplicated here. The detailed results of the ecological risk analysis are presented in Sections 6.0, 7.0, and 8.0, and are also not duplicated here.

The conclusions presented here are based on the information provided in Sections 2.0 through 8.0

### 9.1 Summary of Potential Human Health Risks

The summary of potential human health risks associated with estimated exposures at the ravines and Beach Area study areas is presented for each exposure scenario (i.e., current recreational and future recreational) in Table 9-1. Adverse noncarcinogenic and carcinogenic effects to recreational users are not expected from potential exposure to COPCs present in surface water or sediment at Janes Ravine, Hutchinson Ravine, and the Beach Area. The uncertainty analysis has determined that many of the exposure factors considered in the evaluation of these risk estimates may have been overestimated. This overestimation of exposure may have resulted in substantially higher risk estimates than would actually be expected to occur.

One example of the potential for overestimation for risk was the consideration of potential risks associated with background exposures. A summary of the potential human health risks associated with background exposures is presented in Table 9-2. A comparison of the potential risks associated with each study area to the background risks presented in Table 9-2 suggest that a portion of the potential risks associated with the ravines and Beach Area study areas may be due to background conditions.

### 9.2 Summary of Potential Ecological Risks

A summary of the ecological risk analyses for Janes and Hutchinson Ravines, and the Beach Area (including the littoral zone of Lake Michigan) is provided in Table 9-3.

#### 9.2.1 Janes and Hutchinson Ravines

Adverse effects to wildlife, including amphibians and aquatic invertebrates, are not expected from potential exposure to ecoCOPCs present in surface water or sediments at Janes or Hutchinson Ravines. Additionally, no adverse effects are expected for ingestion of prey species from the ravine areas by the raccoon.

### 9.2.2 Beach Area

Adverse effects from ingestion of ecoCOPCs detected in sediment and surface water are not anticipated for wildlife foraging along the Beach Area. It should be noted that EQs for aluminum and arsenic for the raccoon ingesting sediment while foraging did exceed one. However, when the home range for the mammal is considered in comparison to the forage area provided at the Beach Area, the EQs are considerably less than one, indicating that adverse effects are not likely to occur. Similarly, for snipes ingesting *L. variegatus* worms from the Beach Area, some potential exists that individuals may be affected by ingestion of chromium and manganese contained in the worm tissue. However, considering the home range of this avian species and similar background concentrations of manganese, there is little potential for significant exposure and adverse effects to occur. No adverse effects are anticipated for aquatic invertebrates that may be present in Beach Area surface water.

### 9.2.3 Lake Michigan

EQs for the two sediment constituents indicate that adverse effects on benthic invertebrates may occur. However, consideration of additional sediment data indicate that the detection of 1,3-dinitrobenzene may be an anomaly and that aluminum concentrations associated with Surplus OU Lake Michigan sediments are less than those found elsewhere in the Lake. Although a conclusive determination of the effects to benthic invertebrates from sediment ecoCOPCs cannot be made, it is anticipated that adverse effects, as a result of the constituents present in the lake sediments, are not expected.

Table 9-1. Summary of Potential Human Health Risks\*

Exposure Scenario	Total Noncarcinogenic Hazard Index	Total Carcinogenic Risk†
<b>Janes Ravine</b>		
Current Recreational	6E-03 to 3E-02	4E-07 to 2E-06
Future Recreational		
Adult	1E-02 to 6E-02	1E-06 to 6E-06
Child	4E-02 to 2E-01	†
<b>Hutchinson Ravine</b>		
Current Recreational	4E-03 to 2E-02	4E-07 to 2E-06
Future Recreational		
Adult	8E-03 to 4E-02	5E-06 to 3E-05
Child	2E-02 to 1E-01	†
<b>Beach Area</b>		
Future Recreational		
Adult	6E-03 to 3E-02	1E-06 to 5E-06
Child	3E-02 to 1E-01	†

\* The range of risks provided are reflective of estimated exposures to the RAE and RME, respectively.

† Lifetime cancer risk estimate. Childhood cancer risks are included in values presented for the adult.

Source: QST, 1998.

Table 9-2. Summary of Potential Human Health Risks for Background\*

Exposure Scenario	Total Noncarcinogenic Hazard Index	Total Carcinogenic Risk †
<b>Janes Ravine</b>		
Current Recreational	1E-04 to 6E-04	3E-08 to 2E-07
Future Recreational		
Adult	4E-04 to 2E-03	8E-07 to 4E-06
Child	8E-03 to 4E-03	†
<b>Hutchinson Ravine</b>		
Current Recreational	8E-04 to 4E-03	1E-07 to 5E-07
Future Recreational		
Adult	4E-03 to 2E-02	1E-06 to 7E-06
Child	9E-03 to 4E-02	†
<b>Beach Area</b>		
Future Recreational		
Adult	2E-03 to 1E-02	3E-07 to 1E-06
Child	1E-02 to 6E-02	†

\* The range of risks provided are reflective of estimated exposures to the RAE and RME, respectively.

† Lifetime cancer risk estimate. Childhood cancer risks are included in values presented for the adult.

Source: QST, 1998.

Table 9-3. Summary of Potential Risks to Ecological Receptors

Exposure Medium	Receptor Type	Number of Time EQ>1	EcoCOPCs with EQ>1	Significance
<b>Janes Ravine</b>				
Sediment	Raccoon	0/8		Results indicate sediments not chronically toxic to benthic invertebrates.
Sediment	<i>Lumbriculus</i> and			
Bioassays	<i>Hyalella</i>			
Surface Water	Shrew	0/3		
Surface Water	Feral Cat	0/3		
Surface Water	Woodchuck	0/3		
Surface Water	Raccoon	0/3		
<b>Hutchinson Ravine</b>				
Sediment	Raccoon	0/33		Results indicate sediments not chronically toxic to benthic invertebrates.
Sediment	<i>Lumbriculus</i> and			
Bioassays	<i>Hyalella</i>			
Surface Water	Shrew	0/10		
Surface Water	Feral Cat	0/10		
Surface Water	Woodchuck	0/10		
Surface Water	Raccoon	0/10		
Surface Water	Amphibians	0/3		
Surface Water	Aq. Invertebrates	0/10		
<i>Lumbriculus</i>	Raccoons	0/11		
<b>Beach Area</b>				
Sediment	Raccoon	2/11	Aluminum	Potential for adverse effects however, consideration of the animals home range significantly reduces the potential for exposure therefore no adverse effects are anticipated.
			Arsenic	
Sediment	Snipes	0/11		
Sediment	<i>Lumbriculus</i>			Results indicate sediments not chronically toxic to benthic invertebrates.
Bioassays				
Surface Water	Shrew	0/2		
Surface Water	Feral Cat	0/2		
Surface Water	Woodchuck	0/2		

Table 9-3. Summary of Potential Risks to Ecological Receptors

Exposure Medium	Receptor Type	Number of Time EQ>1	EcoCOPCs with EQ>1	Significance
<b>Beach Area (cont.)</b>				
Surface Water	Raccoon	0/2		
<i>Lumbriculus</i>	Snipes	2/11	Chromium, total  Manganese	Some potential for adverse effects but consideration of the home range should reduce the potential for exposure and any adverse effects.. Additionally, consideration of background concentrations of manganese in prey do not indicate adverse effects
Surface Water	Aq. Invertebrates	0/3		
<i>Lumbriculus</i>	Raccoons	0/11		
<b>Lake Michigan</b>				
Surface Water Bioassays	Fathead Minnows			Results indicate groundwater not acutely toxic to fish species.

Source: QST, 1998.



## 10.0 References

- Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Prepared by Research Triangle Institute for U.S. Public Health Service, Atlanta, Georgia. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, Florida.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1995a. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). Update. Prepared by Research Triangle Institute for U.S. Public Health Service, Atlanta, GA. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, FL.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1995b. Toxicological Profile for Chloroform. Draft Update. Prepared by Research Triangle Institute for U.S. Public Health Service, Atlanta, GA. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, FL.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1995c. Toxicological Profile for Naphthalene. Update. Prepared by Research Triangle Institute for U.S. Public Health Service, Atlanta, GA. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, FL.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1994a. Toxicological Profile for Chlordane. Update. Prepared by Syracuse Research Corporation for U.S. Public Health Service, Atlanta, GA. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, FL.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1994b. Toxicological Profile for 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD. Update. Prepared by Clement International Corporation for U.S. Public Health Service, Atlanta, GA. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, FL.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1993a. Toxicological Profile for Arsenic. Prepared by Life Systems Incorporated for U.S. Public Health Service, Atlanta, GA. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, FL.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1993b. Toxicological Profile for Di(2-Ethylhexyl) Phthalate. Prepared by Life Systems Incorporated for U.S. Public Health Service, Atlanta, GA. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, FL.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1993c. Toxicological Profile for Endosulfan. Prepared by Life Systems Incorporated for U.S. Public Health Service, Atlanta, GA. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, FL.

- Agency for Toxic Substances and Disease Registry (ATSDR). 1992. Toxicological Profile for Manganese. Prepared by Life Systems Incorporated for U.S. Public Health Service, Atlanta, GA. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, FL.
- Agency for Toxic Substances and Disease Registry, 1990. Toxicological Profile for PAHs. Update. Prepared by Life Systems Incorporated for U.S. Public Health Service, Atlanta, GA. ATSDR's Toxicological Profiles on CD-ROM (1997), Produced by CRC Lewis Publishers, Boca Raton, FL.
- Animal Control Center. 1997. verbal communication on January 16, 1997.
- Argonne National Laboratory (ANL). 1989. Enhanced Preliminary Assessment Report. Prepared for U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland.
- Baes, C.F., Sharp, R.D., Sjoreen, A.L., and Shor, R.W. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture. Oak Ridge National Laboratory. ORNL-5786.
- Burrows, E.P., Rosenblat, D.H., Mitchell, W.R., and Parmer, D.L. 1989. Organic Explosives and Related Compounds: Environmental and Health Considerations. U.S. Army Biomedical Research and Development Laboratory, Fort Detrick, Frederick, MD. Technical Report 8901.
- Burt and Grossenheider. 1980. Peterson Field Guides - Mammals.
- Cook, D.G. 1975. A Preliminary Report on the Benthic Macroinvertebrates of Lake Superior. Fish. Res. Board Can., Fish. Mar. Serv. Tech. Rept. 572.
- de Kock, W. C. and W.C. Bowmer. 1993. Bioaccumulation, biological effects and food chain transfer of contaminants in the zebra mussel, *Dreissena polymorpha*. In: Zebra Mussels Biology, Impacts, and Control, T. Nalepa and D. Schloesser, Eds. Lewis Press, Ann Arbor, Michigan.
- Eadie, Brian J. 1982. The Cycling of Toxic Organics in the Great Lakes: A Three-Year Status Report. U.S. Department of Commerce, NOAA, Environmental Research Laboratories.
- Ecological Planning and Toxicology, Inc. (EPT). 1996. Toxicity Extrapolations in Terrestrial Systems. Submitted to Office to Environmental Health Hazard Assessment, Reproductive and Cancer Hazard Assessment Section, California Environmental Protection Agency. Sacramento, California.
- Eisler, R. 1987. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates-A Synoptic Review. U.S. Fish and Wildlife Service, Laurel, Maryland.
- Environmental Science & Engineering, Inc. (ESE). 1997. Final Background Sampling and Data Evaluation Report. Fort Sheridan, Illinois. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland.

- Environmental Science & Engineering, Inc. (ESE). 1996a. Final Groundwater Classification Document, Fort Sheridan, Illinois. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland.
- Environmental Science & Engineering, Inc. (ESE). 1996b. Final Revised Final Technical Evaluation Plan, Fort Sheridan RI/FS. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland.
- Environmental Science & Engineering, Inc. (ESE). 1995. Final Overall Quality Assurance Project Plan, Remedial Investigation/Feasibility Study, Fort Sheridan, Illinois. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland. ESE No. 490-2087-0110.
- Environmental Science & Engineering, Inc. (ESE). 1989. Biota Remedial Investigation. Final Report. Prepared for Office of the Program Manager, Rocky Mountain Arsenal, Denver, CO. Contract No. DAAK11-84-DOO16, Task 9. Gainesville, FL.
- Faust, R. 1994. Toxicity Summary for Benzo(a)pyrene. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland. Oak Ridge National Laboratory, Oak Ridge, Tennessee.
- Faust, R. 1994a. Toxicity Summary for Acenaphthene. Oak Ridge National Laboratory, Oak Ridge, Tennessee. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland.
- Faust, R. 1994b. Toxicity Summary for Acenaphthalene. Oak Ridge National Laboratory, Oak Ridge, Tennessee. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland.
- Faust, R. 1993a. Toxicity Summary for Fluoranthene. Oak Ridge National Laboratory, Oak Ridge, Tennessee. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland.
- Faust, R. 1993b. Toxicity Summary for Naphthalene. Oak Ridge National Laboratory, Oak Ridge, Tennessee. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland.
- Faust, R. 1993c. Toxicity Summary for Phenanthrene. Oak Ridge National Laboratory, Oak Ridge, Tennessee. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland.
- Faust, R. 1993d. Toxicity Summary for Pyrene. Oak Ridge National Laboratory, Oak Ridge, Tennessee. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland.
- Gerlach, S.A. 1978. Food-chain Relationships in Subtidal Silty Sand Marine Sediments and the Role of Meiofauna in Stimulating Bacterial Productivity. *Oecologia* 33:5-69.
- Gerlach, S.A. 1971. On the Importance of Marine Meiofauna for Benthos Communities. *Oecologia* 6:176-190.
- Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold Company, New York, New York.

- Gough, L.P., Shacklette, H.T., and Case, A.A. 1979. Element Concentrations Toxic to Plants, Animals, and Man. U.S. Geological Survey, Department of the Interior, Washington, DC. Survey Bulletin 1466.
- Gross, D., R.L. Muhly, H.K. Woods, R.L. Yon, D.J. Wenz, J.D. Wienand, and N.P. Leibel, 1982. Preliminary Assessment of Fort Sheridan and Joliet Training Area, Illinois; prepared for U.S. Army Toxic and Hazardous Materials Agency; Aberdeen Proving Ground, Maryland.
- Haspel, C. and R. Calhoon. 1989. Home Ranges of Free-Ranging Cats in Brooklyn, New York. *Zoology*, 67:178-181.
- Hatch, R.C. 1977. Poisons Causing Nervous Stimulation or Depression In: *Veterinary Pharmacology and Therapeutics*. Jones, L.M., Booth, N.H., and McDonald, L.E., Eds. Iowa State University Press, Ames, IA.
- Hazardous Substances Data Base (HSDB). 1997. USEPA, Washington, D.C. TOMES® PLUS Information System CD-ROM, Version 32, Expires 4/30/97. Managed by Micromedex, Inc., Englewood, Colorado.
- Hilton, J.W. and W.J. Bettger. 1988. *Aquatic Toxicol.* 12(1):63-72 (cited in HSDB, 1995).
- Hollander, M. and Wolfe, D.A. 1973. *Nonparametric Statistical Methods*. John Wiley & Sons, New York.
- Hobbs, H.H., III. 1991. *Ecology and Classification of North American Freshwater Invertebrates*. Decapoda, Chapter 22, J.H. Thorp and A.P. Covich (eds.) Academic Press, Inc. New York.
- Illinois Environmental Protection Agency (IEPA). 1997. Illinois Register, Title 35, Subtitle G, Chapter 1, Subchapter f, Part 742: Tiered Approach to Corrective Action Objectives (TACOs); Final Rule. Pollution Control Board, Springfield, Illinois. June 5, 1997.
- Illinois Environmental Protection Agency (IEPA). 1994. A Summary of Selected Background Conditions for Inorganics in Soil. Office of Chemical Safety. August 1994. IEPA/ENV/94-161.
- Johnson, Johnson, and Roy, Inc. (JJR). 1994. Fort Sheridan Concept Plan. Fort Sheridan Joint Planning Committee, Lake Forest, Illinois.
- Jones, D.S. *et al.* 1996. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment Associated Biota: 1996 Revision. U.S. Department of Energy. ES/ER/TM.
- Kabata-Pendias, A. and Pendias, H. 1989. *Trace Elements in Soils and Plants*. CRC Press, Boca Raton, Florida.
- Lawrence Livermore National Laboratory (LLNL). 1987. Conventional Weapons Demilitarization: A Health and Environmental Effect Data Base Assessment: Explosives and their Co-Contaminants Final Report. Prepared for U.S. Army Medical Research and Development Command. NTIS AD-A220 588. Livermore, CA.

- Ledet, A.E., Duncan, J.R., Buck, W.B., and Ramsey, F.K. 1973. Clinical, Toxicological, and Pathological Aspects of Arsanilic Acid Poisoning in Swine. Clin. Toxicol., 6:439.
- Lowery, C.H., Jr. 1974. The Mammals of Louisiana and Its Adjacent Waters.
- McIntyre, A.D. 1969. Ecology of Marine Meiobenthos. Biol. Rev. 44:245-290.
- Mitzelfelt, J.D. 1996. Sediment Classification for Illinois Inland Lakes (1996 Update). Illinois Environmental Protection Agency, Springfield, Illinois.
- Montgomery, D.C. 1984. Design and Analysis of Experiments. 2nd Ed. John Wiley & Sons, New York.
- Mortimer, C.H. 1975. Physical characteristics of Lake Michigan and its response to applied forces. In Environmental status of the Lake Michigan region, Vol. 2. ANL/ES-40. Argonne Natl. Lab., Argonne, Illinois.
- Nalepa, T.F. and M.A. Quigley. 1982. The Macro- and Meiobenthos of Southeastern lake Michigan Near the Mouth of the Grand River. U.S. Department of Commerce, NOAA, Environmental Research Laboratories.
- National Academy of Sciences (NAS). 1989. Recommended Daily Allowances. 10th Ed. National Research Council and Food and Nutrition Board, Washington, District of Columbia.
- National Institute of Occupational Safety and Health (NIOSH). 1997. Registry of Toxic Effects of Chemical Substances (RTECS). Cincinnati, OH. TOMES PLUS® Information System CD-ROM, Version 33, Expires 7/31/97. Managed by Micromedex, Inc., Englewood, CO.
- National Institute of Occupational Safety and Health (NIOSH). 1985. Registry of Toxic Effects of Chemical Substances (RTECS). Cincinnati, OH. TOMES PLUS® Information System CD-ROM, Version 33, Expires 7/31/97, Managed by Micromedex, Inc., Englewood, Colorado.
- National Oceanic and Atmospheric Administration (NOAA). 1990. Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. U.S. National Ocean Service, Rockville, Maryland. PB91-172288. March 1990.
- Oak Ridge National Laboratory (ORNL). 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. Prepared for U.S. Department of Energy. Health and Safety Research Division, Oak Ridge, TN. ORNL-5786.
- QST Environmental Inc. (QST). 1997. Draft Final Remedial Investigation/Baseline Risk Assessment for the Landfills 3 and 4 Operable Unit, Fort Sheridan, Illinois. Prepared for U.S. Army Environmental Center, Base Closure Division, Aberdeen Proving Ground, Maryland. June 4, 1997.
- Roper, J.M., D.S. Cherry, J.W. Simmers, and H.E. Tatem. 1996. Bioaccumulation of Toxicants in the Zebra Mussel, *Dreissena polymorpha*, at the Times Beach Confined Disposal Facility, Buffalo, New York. Environmental Pollution 94(2): 117-129.

- Sample, B.E. *et al.* 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Prepared by Risk Assessment Program, Lockheed Martin Energy System, Inc.
- SAS. 1996. SAS/STAT® Procedures Guide. Version 6.12. SAS Institute, Cary, North Carolina.
- Sax, N. Irving and Richard J. Lewis. 1989. Dangerous Properties of Industrial Materials, Sixth Edition. Published by Van Nostrand Company, Inc.
- Schelske, C.L. 1980. Dynamics of Nutrient Enrichment in Large Lakes: The Lake Michigan Case. In U.S. Environmental Protection Agency, Restoration of Lakes and Inland Waters, International Symposium on Inland Waters and Lake Restoration, EPA 440/5-81-010, Portland Maine, September 1980.
- Secor, C.K., E.L. Mills, J. Harshbarger, H.T. Kuntz, W.H. Gutenmann, and D.J. Lisk. 1993. Bioaccumulation of Toxicants, Element and Nutrient Composition and Soft Tissue Histology of Zebra Mussels (*Dreissena polymorpha*) from New York State Waters. *Chemosphere* 26(8): 1559-1575.
- Seljankina, K.P. 1961. Data for Determining the Maximum Permissible Content of Vanadium in Water Basins. *Gig. 1, Sanit.* 26(10):6-12 (in Russian) (cited in WHO, 1988).
- Sheldon, W.G. 1975. *The Book of the American Woodcock.* the University of Massachusetts Press.
- Shortelle, A.B., M.C. Burnett, A.B. Beach, and D. Harrison. 1997. Estimate of Acute Toxicity Via Inhalation for Avian Species for Episodic Exposure to Plumes from Munitions Tests. *Proceeding of the Air & Waste Management Association Meetings*, Toronto, Canada.
- Suter, G.W. II and Tsao. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. Prepared for U.S. Department of Energy by Risk Assessment Program, Health Sciences Research Division, Oak Ridge, Tennessee.
- Suter, G.W. II and M.E. Will. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. Prepared by Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee.
- Taylor, C.A., M.L. Warren Jr., J.F. Fitzpatrick, H.H. Hobbs III, R.F. Jezerinac, W.L. Pflieger, and H.W. Robison. 1996. Conservation Status of Crayfishes of the United States and Canada. *Fisheries* 21(4):25-38.
- U.S. Army Corps of Engineers (USACE). 1990. Fort Sheridan, Illinois Base Closure Final Environmental Impact Statement. Prepared for U.S. Army. Prepared by USACE and Harland Bartholomew & Associated, Inc. Louisville, Illinois.
- U.S. Army Environmental Center (USAEC). 1995. The Installation Restoration Data Management Information System (IRDMIS) User's Guide. Vol. II: Data Dictionary. Aberdeen Proving Ground, Maryland. Edition 1995.2, Revised May 1, 1995.

- USEPA. 1998. Integrated Risk Information System (IRIS). On-Line Database [www.epa.gov/iris]. Washington, District of Columbia. Revised February 10, 1998.
- USEPA. 1997a. Health Effects Assessment Summary Tables (HEAST). FY-1997 Update. Office of Emergency and Remedial Response and Office of Research and Development, Washington, District of Columbia. EPA 540/R-97-036. Publication No. 9200.6-303(97-1). NTIS No. PB97-921199.
- USEPA. 1997b. Updated Risk-Based Concentration Table. Prepared by E.W. Johnson, Technical Support Section, USEPA Region III, Philadelphia, Pennsylvania. October 22, 1997.
- USEPA. 1996a. Region 9 Preliminary Remediation Goals 1996. Prepared by S.J. Smucker, Technical Support Section, USEPA Region IX, Sacramento, California. August 1, 1996.
- USEPA. 1996b. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response, Washington, District of Columbia. EPA/540/R-95/128. NTIS No. PB96-963502.
- USEPA. 1996c. Supplemental Guidance to RAGS: Region 4 Bulletins. Waste Management Division, Office of Health Assessment, USEPA Region IV, Atlanta, GA. October 1996.
- USEPA. 1996d. Eco Update-Ecotox Thresholds. Office of Solid Waste and Emergency Response. Publication 9345.0-12FSI.
- USEPA. 1995a. Exposure Factors Handbook. Review Draft. Office of Research and Development. Washington, District of Columbia. EPA/600/P-95/002A.
- USEPA. 1995b. Guidance for Risk Characterization. Science Policy Council. Memorandum from Carol Browner to Assistant Administration, Associate Administration, Regional Administration, General Counsel and Inspector General. March 21, 1995.
- USEPA. 1995c. Terrestrial Ecological Risk Assessment. Army Materials Technology Laboratory. SS1M-AEC-BC-CR-95071N.
- USEPA. 1994a. Evaluating and Identifying Contaminants of Concern for Human Health. Region VIII Superfund Technical Guidance RA-03: Contaminants of Concern. Denver, Colorado.
- USEPA. 1994b. National Primary Drinking Water Standards. Office of Water, Washington, District of Columbia. EPA 810-F-94-001A. February 1994.
- USEPA. 1993a. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. Office of Solid Waste and Emergency Response, Washington, District of Columbia. EPA-540/R-94/012. NTIS No. PB94-963501. February 1993.
- USEPA. 1993b. Ecological Risk Assessment of Terrestrial Components at the Cottman Avenue Site.
- USEPA. 1992a. Guidelines for Exposure Assessment. Office of Health and Environmental Assessment. Federal Register 57:22888-22938.

- USEPA. 1992b. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities: Addendum to Interim Final Guidance. Office of Solid Waste, Permits and State Programs Division, Washington, District of Columbia.
- USEPA. 1992c. Supplemental Guidance to RAGS: Calculating the Concentration Term. Office of Solid Waste and Emergency Response, Washington, DC. Publication 9285.7-081. May 1992.
- USEPA. 1992d. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Addendum to Interim Final Guidance. Office of Solid Waste. Permits and State Programs Division. Washington, District of Columbia. July 1992.
- USEPA. 1991. Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors. OSWER Directive 9285.6-03. Office of Emergency and Remedial Response. Washington, District of Columbia.
- USEPA. 1990. Guidance for Data Useability in Risk Assessments. Office of Emergency and Remedial Response. Washington, District of Columbia.
- USEPA. 1989a. Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual, Part A. Office of Emergency and Remedial Response, Washington, District of Columbia. EPA/540/1-89/002.
- USEPA. 1989b. Risk Assessment Guidance for Superfund: Volume II. Environmental Evaluation Manual, Interim Final. Office of Emergency and Remedial Response, Washington, District of Columbia. EPA 540/1-89/001.
- USEPA. 1989c. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities. EPA/530-SW-89-026. PB89-151047.
- USEPA. 1989d. Health Advisory for Chloromethane. Criteria and Standards Division, Office of Drinking Water, Washington, District of Columbia. October 1989.
- USEPA. 1988a. Superfund Exposure Assessment Manual. Office of Remedial Response, Washington District of Columbia. EPA/540/1.88/001 OSWER Directive 9285.5-1.
- USEPA. 1988b. Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis (Functional Guidelines for Organics). Office of Emergency and Remedial Response, Washington, District of Columbia. (Cited in USEPA, 1989a).
- USEPA. 1988c. Ambient Water Quality Criteria for Aluminum. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, DC. EPA 440/5-86/008.
- USEPA. 1987. Health Effects Assessment for Zinc (and Compounds). PB86-134657.
- USEPA. 1986a. Guidelines for Carcinogen Risk Assessment. Office of Health and Environmental Assessment. Washington, District of Columbia.



- USEPA. 1986b. Guidelines for the Health Risk Assessment of Chemical Mixtures. Office of Health and Environmental Assessment. Washington, District of Columbia.
- USEPA. 1985. Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites. Final Report. Prepared by Clement Associates, Inc., Arlington, Virginia.
- USEPA. 1983a. Methods for Assessing Exposure to Windblown Particulates. Office of Health and Environmental Assessment. Washington, District of Columbia. EPA/600-4-83-007.
- USEPA. 1983b. Hazardous Waste Land Treatment. Municipal Environmental Research Laboratory, Office of Research and Development, Cincinnati, OH. Technical Report.
- U.S. Navy. 1995. Natural Resources Management Plan. Great Lakes Annex NAS Glenview and Great Lakes Housing at Fort Sheridan. Prepared by Primera Engineers Ltd. Fish and Wildlife, Naval Training Center Great Lakes, Illinois. October 1995.
- Wells, L. and A.L. McClain. 1973. Lake Michigan: Man's Effects on Native Fish Stocks and other Biota. Great Lakes Fish. Comm. Tech. Rep. 20:55p.
- Wentzel *et al.* 1996. Tri-Service Procedural Guideline for Ecological Risk Assessments. U.S. Army, Edgewood Research, Development, and Engineering Center, Aberdeen Proving Ground, Maryland. May 1996.
- Windholz, M., Budavari, S., Stroumtsos, L., and Fertig, M. 1976. The Merck Index. 9th Ed. Merck & Co., Inc, Rahway, New Jersey.
- World Health Organization (WHO). 1991. Environmental Health Criteria 108-Nickel. Geneva.
- World Health Organization (WHO). 1990. Environmental Health Criteria 107-Barium. Geneva.
- World Health Organization (WHO). 1989. DDT and its Derivatives-Environmental Aspects. Finland.

**This page left blank intentionally**

## **Appendix A**

### **QA/QC Summary**

## **Appendix A1**

Appendix A1. Human Risk Assessment TIC Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravine BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Background Ravine	Decane	3.60E-01	3.60E-01	3.60E-01	.	.	.	mg/kg	1	1
		Dodecane	4.80E-01	5.00E-01	4.90E-01	.	.	.	mg/kg	2	2
		Heptadecane	3.60E-01	5.00E-01	4.30E-01	.	.	.	mg/kg	2	2
		Hexadecane	3.70E-01	4.80E-01	4.25E-01	.	.	.	mg/kg	2	2
		Hexadecanoic acid	4.80E-01	4.80E-01	4.80E-01	.	.	.	mg/kg	1	1
		Nonacosane	3.70E-01	3.70E-01	3.70E-01	.	.	.	mg/kg	1	1
		Octadecane	3.60E-01	3.60E-01	3.60E-01	.	.	.	mg/kg	1	1
		Pentadecane	4.80E-01	5.00E-01	4.90E-01	.	.	.	mg/kg	2	2
		Sulfur, molecular	4.70E-01	1.00E+01	3.24E+00	.	.	.	mg/kg	6	6
		Tetradecane	4.80E-01	6.20E-01	5.50E-01	.	.	.	mg/kg	2	2
		Trichlorofluoromethane	6.50E-03	6.50E-03	6.50E-03	.	.	.	mg/kg	1	1
		Tridecane	3.90E-01	6.20E-01	4.97E-01	.	.	.	mg/kg	3	3
		Undecane	4.80E-01	5.00E-01	4.90E-01	.	.	.	mg/kg	2	2
Sediment	Beach	Decane	3.50E-01	4.90E-01	4.20E-01	.	.	.	mg/kg	2	2
		Heptadecane	3.50E-01	4.90E-01	4.20E-01	.	.	.	mg/kg	2	2
		Hexadecane	3.50E-01	3.70E-01	3.60E-01	.	.	.	mg/kg	2	2
		Tetradecane	4.90E-01	4.90E-01	4.90E-01	.	.	.	mg/kg	1	1
		Tetramethylpentadecane, 2,6,10,14-	3.50E-01	8.50E-01	5.93E-01	.	.	.	mg/kg	3	3
		Trichloro-1,2,2-trifluoroethane, 1,1,2-	7.30E-03	7.30E-03	7.30E-03	.	.	.	mg/kg	1	1
		Tridecane	3.50E-01	6.10E-01	4.37E-01	.	.	.	mg/kg	3	3
		Undecane	3.40E-01	3.40E-01	3.40E-01	.	.	.	mg/kg	1	1
Sediment	Hutchinson Ravine	Benzo(e)pyrene	2.00E+00	6.00E+00	3.55E+00	.	.	.	mg/kg	4	4
		DDT, o,p'-	3.60E-01	3.60E-01	3.60E-01	.	.	.	mg/kg	1	1
		Decane	4.70E-01	4.70E-01	4.70E-01	.	.	.	mg/kg	1	1
		Dimethylnaphthalene, 1,3-	2.00E+00	2.00E+00	2.00E+00	.	.	.	mg/kg	1	1
		Dimethylundecane, 2,6-	3.60E-01	3.60E-01	3.60E-01	.	.	.	mg/kg	1	1
		Dodecane	5.90E-01	5.90E-01	5.90E-01	.	.	.	mg/kg	1	1
		Ricosane	3.80E-01	3.80E-01	3.80E-01	.	.	.	mg/kg	1	1
		Heptacosane	4.10E-01	4.10E-01	4.10E-01	.	.	.	mg/kg	1	1
		Heptacosane	1.00E+00	4.10E+00	2.55E+00	.	.	.	mg/kg	2	2
		Heptadecane	3.60E-01	7.70E-01	5.13E-01	.	.	.	mg/kg	3	3
		Hexacosane	4.10E-01	4.10E-01	4.10E-01	.	.	.	mg/kg	1	1
		Hexadecane	3.60E-01	2.00E+00	8.36E-01	.	.	.	mg/kg	5	5
		Hexadecanoic acid	5.30E-01	2.00E+00	1.02E+00	.	.	.	mg/kg	7	7
		Methylpyrene, 1-	3.80E-01	4.90E-01	4.35E-01	.	.	.	mg/kg	2	2
		Nonacosane	2.30E+00	2.00E+01	7.69E+00	.	.	.	mg/kg	7	7
		Nonane	3.60E-01	3.60E-01	3.60E-01	.	.	.	mg/kg	1	1
		Octacosane	5.40E-01	5.40E-01	5.40E-01	.	.	.	mg/kg	1	1
		Octadecane	5.10E-01	5.40E-01	5.25E-01	.	.	.	mg/kg	2	2
		Pentadecane	4.70E-01	2.00E+00	8.72E-01	.	.	.	mg/kg	4	4
		Sitosterol, gamma-	7.40E-01	8.00E+00	3.58E+00	.	.	.	mg/kg	7	7
		Sulfur, molecular	9.30E-01	6.00E+00	3.01E+00	.	.	.	mg/kg	5	5
		Tetradecane	4.10E-01	4.70E-01	4.40E-01	.	.	.	mg/kg	2	2
		Tetramethylpentadecane, 2,6,10,14-	3.70E-01	3.00E+00	1.12E+00	.	.	.	mg/kg	5	5
		Trichloro-1,2,2-trifluoroethane, 1,1,2-	7.70E-03	7.70E-03	7.70E-03	.	.	.	mg/kg	1	1
		Tricosane	5.40E-01	5.40E-01	5.40E-01	.	.	.	mg/kg	1	1
		Tridecane	5.90E-01	2.00E+00	1.30E+00	.	.	.	mg/kg	2	2
		Trimethylnaphthalene, 1,4,6-	2.00E+00	2.00E+00	2.00E+00	.	.	.	mg/kg	1	1
		Undecane	7.10E-01	7.10E-01	7.10E-01	.	.	.	mg/kg	1	1

Appendix A1. Human Risk Assessment TIC Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravine BRA

9:39 Thursday, February 26, 1998 2

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Janes Ravine	Decane	3.50E-01	5.20E-01	4.42E-01	.	.	.	mg/kg	5	5
		Dimethylundecane, 2,6-	6.50E-01	6.50E-01	6.50E-01	.	.	.	mg/kg	1	1
		Dodecane	3.50E-01	9.10E-01	6.12E-01	.	.	.	mg/kg	4	4
		Eicosane	5.20E-01	5.20E-01	5.20E-01	.	.	.	mg/kg	2	2
		Heptacosane	5.20E-01	5.20E-01	5.20E-01	.	.	.	mg/kg	2	2
		Heptacosane	4.60E-01	4.70E-01	4.65E-01	.	.	.	mg/kg	2	2
		Heptacosane	3.50E-01	1.00E+00	6.53E-01	.	.	.	mg/kg	4	4
		Hexadecane	3.50E-01	9.20E-01	5.50E-01	.	.	.	mg/kg	5	5
		Nonacosane	1.10E+00	1.10E+00	1.10E+00	.	.	.	mg/kg	1	1
		Nonacosane	5.20E-01	9.20E-01	7.20E-01	.	.	.	mg/kg	2	2
		Octadecane	4.60E-01	7.90E-01	6.25E-01	.	.	.	mg/kg	2	2
		Pentadecane	4.70E-01	9.10E-01	6.40E-01	.	.	.	mg/kg	4	4
		Sitosterol, gamma-	4.60E-01	4.60E-01	4.60E-01	.	.	.	mg/kg	1	1
		Sulfur, molecular	2.30E+00	2.30E+00	2.30E+00	.	.	.	mg/kg	1	1
		Tetradecane	4.60E-01	9.10E-01	6.10E-01	.	.	.	mg/kg	4	4
		Tetramethylpentadecane, 2,6,10,14-	5.80E-01	1.30E+00	1.06E+00	.	.	.	mg/kg	3	3
		Tridecane	4.60E-01	1.30E+00	7.37E-01	.	.	.	mg/kg	4	4
		Undecane	4.60E-01	8.40E-01	6.37E-01	.	.	.	mg/kg	4	4
Surface Water	Background Ravine	Diethyl-3-methylbenzamide, N,N-Propanol, 2-	8.00E-03	5.00E-01	2.54E-01	.	.	.	mg/L	2	2
			1.00E-02	1.00E+00	3.10E-01	.	.	.	mg/L	5	5
Surface Water	Hutchinson Ravine	Diethyl-3-methylbenzamide, N,N-Hexadecanoic acid	8.00E-03	5.00E-02	2.90E-02	.	.	.	mg/L	2	2
		Nonacosane	5.00E-03	5.00E-03	5.00E-03	.	.	.	mg/L	1	1
		Propanol, 2-	5.00E-03	5.00E-03	5.00E-03	.	.	.	mg/L	1	1
		Tetrachloro-1,3-xylene, 2,4,5,6-	1.00E-02	3.00E+00	1.01E+00	.	.	.	mg/L	3	3
			7.26E-04	7.77E-04	7.51E-04	.	.	.	mg/L	3	3

d:\mary\fisher2\surplus\drift\al\bchra\tics\humatics.lst  
c:\prof\sheridan\surplus\beachrav\bra2\append2\humatics.lst

Appendix A1. Ecological Risk Assessment TIC Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

9:37 Thursday, February 26, 1998 1

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Groundwater	Background	Cyclohexanol	4.00E-03	4.00E-03	4.00E-03	.	.	.	mg/L	1	1
		Diacetone alcohol	6.00E-03	6.00E-03	6.00E-03	.	.	.	mg/L	2	2
Groundwater	Beach	Aniline	2.00E-02	2.00E-02	2.00E-02	.	.	.	mg/L	1	1
		Benzothiazole	4.00E-03	6.00E-02	2.48E-02	.	.	.	mg/L	4	4
		Caprolactam	8.00E-03	3.00E-01	6.96E-02	.	.	.	mg/L	5	5
		Diethylene glycol monobutyl ether	4.00E-03	4.00E-03	4.00E-03	.	.	.	mg/L	1	1
		Epoxycyclohexene, 1,2-	5.00E-03	2.00E-02	1.25E-02	.	.	.	mg/L	2	2
		Hexanedioic acid dioctyl ester	1.00E-02	1.00E-02	1.00E-02	.	.	.	mg/L	1	1
		Octadecanoic acid	1.00E-02	1.00E-02	1.00E-02	.	.	.	mg/L	1	1
		Trichloro-1,2,2-trifluoroethane, 1,1,2-	8.00E-03	1.00E-02	9.00E-03	.	.	.	mg/L	2	2
		Trichloroethane, 1,1,2-	6.00E-03	6.00E-03	6.00E-03	.	.	.	mg/L	1	1
Sediment	Background Ravine	Decane	3.60E-01	3.60E-01	3.60E-01	.	.	.	mg/kg	1	1
		Dodecane	4.80E-01	5.00E-01	4.90E-01	.	.	.	mg/kg	2	2
		Heptadecane	3.60E-01	5.00E-01	4.30E-01	.	.	.	mg/kg	2	2
		Hexadecane	3.70E-01	4.80E-01	4.25E-01	.	.	.	mg/kg	2	2
		Hexadecanoic acid	4.80E-01	4.80E-01	4.80E-01	.	.	.	mg/kg	1	1
		Nonacosane	3.70E-01	3.70E-01	3.70E-01	.	.	.	mg/kg	1	1
		Octadecane	3.60E-01	3.60E-01	3.60E-01	.	.	.	mg/kg	1	1
		Pentadecane	4.80E-01	5.00E-01	4.90E-01	.	.	.	mg/kg	2	2
		Sulfur, molecular	4.70E-01	1.00E+01	3.24E+00	.	.	.	mg/kg	6	6
		Tetradecane	4.80E-01	6.20E-01	5.50E-01	.	.	.	mg/kg	2	2
		Trichlorofluoromethane	6.50E-03	6.50E-03	6.50E-03	.	.	.	mg/kg	1	1
		Tridecane	3.90E-01	6.20E-01	4.97E-01	.	.	.	mg/kg	3	3
		Undecane	4.80E-01	5.00E-01	4.90E-01	.	.	.	mg/kg	2	2
Sediment	Beach	Decane	3.50E-01	4.90E-01	4.20E-01	.	.	.	mg/kg	2	2
		Heptadecane	3.50E-01	4.90E-01	4.20E-01	.	.	.	mg/kg	2	2
		Hexadecane	3.50E-01	3.70E-01	3.60E-01	.	.	.	mg/kg	2	2
		Tetradecane	4.90E-01	4.90E-01	4.90E-01	.	.	.	mg/kg	1	1
		Tetramethylpentadecane, 2,6,10,14-	3.50E-01	8.50E-01	5.93E-01	.	.	.	mg/kg	3	3
		Trichloro-1,2,2-trifluoroethane, 1,1,2-	7.30E-03	7.30E-03	7.30E-03	.	.	.	mg/kg	1	1
		Tridecane	3.50E-01	6.10E-01	4.37E-01	.	.	.	mg/kg	3	3
		Undecane	3.40E-01	3.40E-01	3.40E-01	.	.	.	mg/kg	1	1

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Hutchinson Ravine	Benzo(e)pyrene	2.00E+00	6.00E+00	3.55E+00	.	.	.	mg/kg	4	4
		DDT, o,p'-	3.60E-01	3.60E-01	3.60E-01	.	.	.	mg/kg	1	1
		Decane	4.70E-01	4.70E-01	4.70E-01	.	.	.	mg/kg	1	1
		Dimethylnaphthalene, 1,3-	2.00E+00	2.00E+00	2.00E+00	.	.	.	mg/kg	1	1
		Dimethylundecane, 2,6-	3.60E-01	3.60E-01	3.60E-01	.	.	.	mg/kg	1	1
		Dodecane	5.90E-01	5.90E-01	5.90E-01	.	.	.	mg/kg	1	1
		Eicosane	3.80E-01	3.80E-01	3.80E-01	.	.	.	mg/kg	1	1
		Heptacosane	4.10E-01	4.10E-01	4.10E-01	.	.	.	mg/kg	1	1
		Heptacosane	1.00E+00	4.10E+00	2.55E+00	.	.	.	mg/kg	2	2
		Heptacosane	3.60E-01	7.70E-01	5.13E-01	.	.	.	mg/kg	3	3
		Hexacosane	4.10E-01	4.10E-01	4.10E-01	.	.	.	mg/kg	1	1
		Hexacosane	3.60E-01	2.00E+00	8.36E-01	.	.	.	mg/kg	5	5
		Hexadecanoic acid	5.30E-01	2.00E+00	1.02E+00	.	.	.	mg/kg	7	7
		Methylpyrene, 1-	3.80E-01	4.90E-01	4.35E-01	.	.	.	mg/kg	2	2
		Nonacosane	2.30E+00	2.00E+01	7.69E+00	.	.	.	mg/kg	7	7
		Nonane	3.60E-01	3.60E-01	3.60E-01	.	.	.	mg/kg	1	1
		Octacosane	5.40E-01	5.40E-01	5.40E-01	.	.	.	mg/kg	1	1
		Octacosane	5.10E-01	5.40E-01	5.25E-01	.	.	.	mg/kg	2	2
		Pentadecane	4.70E-01	2.00E+00	8.72E-01	.	.	.	mg/kg	4	4
		Sitosterol, gamma-	7.40E-01	8.00E+00	3.58E+00	.	.	.	mg/kg	7	7
		Sulfur, molecular	9.30E-01	6.00E+00	3.01E+00	.	.	.	mg/kg	5	5
		Tetradecane	4.10E-01	4.70E-01	4.40E-01	.	.	.	mg/kg	2	2
Sediment	Janes Ravine	Tetramethylpentadecane, 2,6,10,14-	3.70E-01	3.00E+00	1.12E+00	.	.	.	mg/kg	5	5
		Trichloro-1,2,2-trifluoroethane, 1,1,2-	7.70E-03	7.70E-03	7.70E-03	.	.	.	mg/kg	1	1
		Tricosane	5.40E-01	5.40E-01	5.40E-01	.	.	.	mg/kg	1	1
		Tridecane	5.90E-01	2.00E+00	1.30E+00	.	.	.	mg/kg	2	2
		Trimethylnaphthalene, 1,4,6-	2.00E+00	2.00E+00	2.00E+00	.	.	.	mg/kg	1	1
		Undecane	7.10E-01	7.10E-01	7.10E-01	.	.	.	mg/kg	1	1
		Decane	3.50E-01	5.20E-01	4.42E-01	.	.	.	mg/kg	5	5
		Dimethylundecane, 2,6-	6.50E-01	6.50E-01	6.50E-01	.	.	.	mg/kg	1	1
		Dodecane	3.50E-01	9.10E-01	6.12E-01	.	.	.	mg/kg	4	4
		Eicosane	5.20E-01	5.20E-01	5.20E-01	.	.	.	mg/kg	2	2
		Heptacosane	5.20E-01	5.20E-01	5.20E-01	.	.	.	mg/kg	2	2
		Heptacosane	4.60E-01	4.70E-01	4.65E-01	.	.	.	mg/kg	2	2
		Hexadecane	3.50E-01	1.00E+00	6.53E-01	.	.	.	mg/kg	4	4
		Nonacosane	1.10E+00	1.10E+00	1.10E+00	.	.	.	mg/kg	5	5
		Nonacosane	5.20E-01	9.20E-01	7.20E-01	.	.	.	mg/kg	1	1
		Octadecane	4.60E-01	7.90E-01	6.25E-01	.	.	.	mg/kg	2	2
		Pentadecane	4.70E-01	9.10E-01	6.40E-01	.	.	.	mg/kg	2	2
		Sitosterol, gamma-	4.60E-01	4.60E-01	4.60E-01	.	.	.	mg/kg	4	4
		Sulfur, molecular	2.30E+00	2.30E+00	2.30E+00	.	.	.	mg/kg	1	1
		Tetradecane	4.60E-01	9.10E-01	6.10E-01	.	.	.	mg/kg	4	4
		Tetramethylpentadecane, 2,6,10,14-	5.80E-01	1.30E+00	1.06E+00	.	.	.	mg/kg	3	3
		Tridecane	4.60E-01	1.30E+00	7.37E-01	.	.	.	mg/kg	4	4
		Undecane	4.60E-01	8.40E-01	6.37E-01	.	.	.	mg/kg	4	4
Surface Water	Background Ravine	Diethyl-3-methylbenzamide, N,N-Propanol, 2-	8.00E-03	5.00E-01	2.54E-01	.	.	.	mg/L	2	2
		Propanol, 2-	1.00E-02	1.00E+00	3.10E-01	.	.	.	mg/L	5	5
Surface Water	Hutchinson Ravine	Diethyl-3-methylbenzamide, N,N-Hexadecanoic acid	8.00E-03	5.00E-02	2.90E-02	.	.	.	mg/L	2	2
		Nonacosane	5.00E-03	5.00E-03	5.00E-03	.	.	.	mg/L	1	1
		Propanol, 2-	5.00E-03	5.00E-03	5.00E-03	.	.	.	mg/L	1	1
		Tetrachloro-1,3-xylene, 2,4,5,6-	1.00E-02	3.00E+00	1.01E+00	.	.	.	mg/L	3	3
		Propanol, 2-	7.26E-04	7.77E-04	7.51E-04	.	.	.	mg/L	3	3



## **Appendix A2**



Appendix A2. Human Risk Assessment Filtered Water Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

08:22 Wednesday, March 4, 1998 2

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Hits
Surface Water	Janes Ravine										
		Copper	9.21E-03	2.49E-02	1.71E-02	5.00E-03	5.00E-03	5.00E-03	mg/L	6	2
		Iron	6.44E-02	3.34E-01	1.99E-01	4.50E-02	4.50E-02	4.50E-02	mg/L	6	2
		Lead	2.50E-03	4.10E-03	3.30E-03	2.00E-03	2.00E-03	2.00E-03	mg/L	6	2
		Magnesium	1.41E+01	6.76E+01	4.91E+01	.	.	.	mg/L	6	6
		Manganese	1.32E-02	1.92E-01	9.57E-02	.	.	.	mg/L	6	6
		Mercury	.	.	.	2.00E-04	2.00E-04	2.00E-04	mg/L	6	0
		Nickel	.	.	.	1.50E-02	1.50E-02	1.50E-02	mg/L	6	0
		Potassium	1.02E+00	3.14E+00	2.64E+00	.	.	.	mg/L	6	6
		Selenium	.	.	.	2.50E-03	2.50E-03	2.50E-03	mg/L	6	0
		Silver	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Sodium	1.05E+01	2.17E+02	5.81E+01	.	.	.	mg/L	6	6
		Thallium	.	.	.	2.50E-03	2.50E-03	2.50E-03	mg/L	6	0
		Vanadium	.	.	.	1.00E-02	1.00E-02	1.00E-02	mg/L	6	0
		Zinc	2.65E-02	3.96E-01	1.50E-01	2.00E-02	2.00E-02	2.00E-02	mg/L	6	3

d:\mary\ftsher2\surpl\ou\drftfin\bcbravs\filtered\humfilt.lst  
c:\proj\sheridan\surpl\ou\beachrav\hra2\appends2\humfilt.lst

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Hits
Groundwater	Background	Aluminum	4.96E-02	1.59E-01	9.14E-02	4.00E-02	4.00E-02	4.00E-02	mg/L	14	4
		Antimony	5.18E-02	5.18E-02	5.18E-02	5.00E-02	5.00E-02	5.00E-02	mg/L	14	1
		Arsenic	2.90E-03	2.90E-03	2.75E-03	2.50E-03	2.50E-03	2.50E-03	mg/L	14	2
		Barium	2.52E-02	3.92E-02	3.11E-02	2.50E-02	2.50E-02	2.50E-02	mg/L	14	11
		Beryllium				5.00E-03	5.00E-03	5.00E-03	mg/L	14	0
		Boron	5.99E-02	6.24E-01	4.25E-01	5.00E-02	5.00E-02	5.00E-02	mg/L	14	13
		Cadmium				5.00E-03	5.00E-03	5.00E-03	mg/L	14	0
		Chromium, total	4.88E+01	8.68E+01	7.43E+01				mg/L	14	14
		Cobalt				1.00E-02	1.00E-02	1.00E-02	mg/L	14	0
		Copper	7.06E-03	7.06E-03	7.06E-03	5.00E-03	5.00E-03	5.00E-03	mg/L	14	1
		Iron	5.88E-02	1.69E-01	1.09E-01	4.50E-02	4.50E-02	4.50E-02	mg/L	14	4
		Lead				2.00E-03	2.00E-03	2.00E-03	mg/L	14	0
		Magnesium	2.84E+01	1.48E+02	8.21E+01				mg/L	14	14
		Manganese	6.85E-03	4.11E-02	2.15E-02	5.00E-03	5.00E-03	5.00E-03	mg/L	14	12
		Mercury				2.00E-04	2.00E-04	2.00E-04	mg/L	14	0
		Nickel				1.50E-02	1.50E-02	1.50E-02	mg/L	14	0
		Potassium	7.73E-01	4.43E+00	2.77E+00				mg/L	14	14
		Selenium				2.50E-03	2.50E-03	2.50E-03	mg/L	14	0
		Silver				5.00E-03	5.00E-03	5.00E-03	mg/L	14	0
		Sodium	3.25E+01	8.48E+01	4.69E+01				mg/L	14	14
Thallium				2.50E-03	2.50E-03	2.50E-03	mg/L	14	0		
Vanadium				1.00E-02	1.00E-02	1.00E-02	mg/L	14	0		
Zinc	2.15E-02	2.15E-02	2.15E-02	2.00E-02	2.00E-02	2.00E-02	mg/L	14	1		
Groundwater	Beach	Aluminum	4.15E-02	1.41E-01	8.14E-02	4.00E-02	4.00E-02	4.00E-02	mg/L	35	14
		Antimony				5.00E-02	5.00E-02	5.00E-02	mg/L	35	0
		Arsenic	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	2.50E-03	mg/L	35	1
		Barium	2.85E-02	6.49E-01	9.65E-02	2.50E-02	2.50E-02	2.50E-02	mg/L	35	23
		Beryllium				5.00E-03	5.00E-03	5.00E-03	mg/L	35	0
		Boron	6.09E-02	8.67E-01	3.63E-01				mg/L	34	34
		Cadmium				5.00E-03	5.00E-03	5.00E-03	mg/L	35	0
		Calcium	2.05E+01	2.70E+02	1.15E+02				mg/L	35	0
		Chromium, total							mg/L	35	35
		Cobalt				1.00E-02	1.00E-02	1.00E-02	mg/L	35	0
		Copper	6.22E-03	8.59E-03	7.41E-03	2.00E-02	2.00E-02	2.00E-02	mg/L	35	0
		Iron	5.06E-02	9.01E-01	1.78E-01	5.00E-03	5.00E-03	5.00E-03	mg/L	35	2
		Lead	2.00E-03	4.10E-03	2.92E-03	4.50E-02	4.50E-02	4.50E-02	mg/L	35	19
		Magnesium	5.19E+00	1.09E+02	4.81E+01	2.00E-03	2.00E-03	2.00E-03	mg/L	35	5
		Manganese	5.61E-03	6.98E-01	1.65E-01	5.00E-03	5.00E-03	5.00E-03	mg/L	35	35
		Mercury				2.00E-04	2.00E-04	2.00E-04	mg/L	35	26
		Nickel				1.50E-02	1.50E-02	1.50E-02	mg/L	35	0
		Potassium	8.02E-01	5.51E+00	2.31E+00				mg/L	35	0
		Selenium				2.50E-03	2.50E-03	2.50E-03	mg/L	35	0
		Silver				5.00E-03	5.00E-03	5.00E-03	mg/L	35	0
Sodium	5.57E+00	7.70E+02	9.59E+01				mg/L	35	35		
Thallium				2.50E-03	2.50E-03	2.50E-03	mg/L	35	0		
Vanadium				1.00E-02	1.00E-02	1.00E-02	mg/L	35	0		
Zinc	2.32E-02	2.63E-02	2.48E-02	2.00E-02	2.00E-02	2.00E-02	mg/L	35	3		
Surface Water	Background Ravine	Aluminum				4.00E-02	4.00E-02	4.00E-02	mg/L	9	0
		Antimony				5.00E-02	5.00E-02	5.00E-02	mg/L	9	0
		Arsenic				2.50E-03	2.50E-03	2.50E-03	mg/L	9	0
		Barium	3.53E-02	9.38E-02	5.69E-02				mg/L	9	9
		Beryllium				5.00E-03	5.00E-03	5.00E-03	mg/L	9	0
		Boron	6.03E-02	2.05E-01	1.21E-01				mg/L	3	3
		Cadmium				5.00E-03	5.00E-03	5.00E-03	mg/L	9	0
		Calcium	6.76E+01	1.25E+02	9.41E+01				mg/L	9	9
		Chromium, total				1.00E-02	1.00E-02	1.00E-02	mg/L	9	0
		Cobalt				2.00E-02	2.00E-02	2.00E-02	mg/L	9	0

Appendix A2. Ecological Risk Assessment Filtered Water Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

09:22 Wednesday, March 4, 1998 2

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Hits
Surface Water	Background Ravine										
		Copper	5.54E-03	6.57E-03	6.22E-03	5.00E-03	5.00E-03	5.00E-03	mg/L	9	4
		Iron				4.50E-02	4.50E-02	4.50E-02	mg/L	9	0
		Lead	2.60E-03	2.60E-03	2.60E-03	2.00E-03	2.00E-03	2.00E-03	mg/L	9	1
		Magnesium	4.62E+01	7.67E+01	5.60E+01				mg/L	9	9
		Manganese	1.02E-02	6.13E-01	1.21E-01				mg/L	9	9
		Mercury				2.00E-04	2.00E-04	2.00E-04	mg/L	9	0
		Nickel				1.50E-02	1.50E-02	1.50E-02	mg/L	9	0
		Potassium	2.82E+00	9.79E+00	3.99E+00				mg/L	9	9
		Selenium				2.50E-03	2.50E-03	2.50E-03	mg/L	9	0
		Silver				5.00E-03	5.00E-03	5.00E-03	mg/L	9	0
		Sodium	2.57E+01	3.07E+02	7.24E+01				mg/L	9	9
		Thallium				2.50E-03	2.50E-03	2.50E-03	mg/L	9	0
		Vanadium				1.00E-02	1.00E-02	1.00E-02	mg/L	9	0
		Zinc				2.00E-02	2.00E-02	2.00E-02	mg/L	9	0
Surface Water	Hutchinson Ravine										
		Aluminum	2.42E-01	2.42E-01	2.42E-01	4.00E-02	4.00E-02	4.00E-02	mg/L	13	1
		Antimony				5.00E-02	5.00E-02	5.00E-02	mg/L	13	0
		Arsenic				2.50E-03	2.50E-03	2.50E-03	mg/L	13	0
		Barium	4.95E-02	8.72E-02	6.75E-02				mg/L	13	13
		Beryllium				5.00E-03	5.00E-03	5.00E-03	mg/L	13	0
		Boron	9.30E-02	1.75E-01	1.35E-01				mg/L	10	10
		Cadmium				5.00E-03	5.00E-03	5.00E-03	mg/L	13	0
		Calcium	9.60E+01	1.44E+02	1.15E+02				mg/L	13	13
		Chromium, total				1.00E-02	1.00E-02	1.00E-02	mg/L	13	0
		Cobalt				2.00E-02	2.00E-02	2.00E-02	mg/L	13	0
		Copper				5.00E-03	5.00E-03	5.00E-03	mg/L	13	0
		Iron	8.52E-02	2.56E-01	1.58E-01				mg/L	13	0
		Lead				2.00E-02	2.00E-02	2.00E-02	mg/L	13	0
		Magnesium	4.69E+01	7.24E+01	5.89E+01				mg/L	13	13
		Manganese	3.55E-02	1.44E+00	4.16E-01				mg/L	13	13
		Mercury				2.00E-03	2.00E-03	2.00E-03	mg/L	13	0
		Nickel				2.00E-04	2.00E-04	2.00E-04	mg/L	13	0
		Potassium	3.03E+00	7.65E+00	5.06E+00				mg/L	13	0
		Selenium				1.50E-02	1.50E-02	1.50E-02	mg/L	13	0
		Silver				2.50E-03	2.50E-03	2.50E-03	mg/L	13	0
		Sodium	4.17E+01	5.50E+02	1.83E+02				mg/L	13	13
		Thallium				2.50E-03	2.50E-03	2.50E-03	mg/L	13	0
		Vanadium				1.00E-02	1.00E-02	1.00E-02	mg/L	13	0
		Zinc				2.00E-02	2.00E-02	2.00E-02	mg/L	13	0
Surface Water	Janes Ravine										
		Aluminum				4.00E-02	4.00E-02	4.00E-02	mg/L	4	0
		Antimony				5.00E-02	5.00E-02	5.00E-02	mg/L	4	0
		Arsenic				2.50E-03	2.50E-03	2.50E-03	mg/L	4	0
		Barium	4.49E-02	7.15E-02	5.83E-02				mg/L	4	4
		Beryllium				5.00E-03	5.00E-03	5.00E-03	mg/L	4	0
		Boron	1.08E-01	1.81E-01	1.37E-01				mg/L	4	4
		Cadmium				5.00E-03	5.00E-03	5.00E-03	mg/L	4	0
		Calcium	9.03E+01	1.11E+02	9.90E+01				mg/L	4	4
		Chromium, total				1.00E-02	1.00E-02	1.00E-02	mg/L	4	0
		Cobalt				2.00E-02	2.00E-02	2.00E-02	mg/L	4	0
		Copper	9.21E-03	9.21E-03	9.21E-03				mg/L	4	0
		Iron				2.00E-02	2.00E-02	2.00E-02	mg/L	4	0
		Lead				5.00E-03	5.00E-03	5.00E-03	mg/L	4	1
		Magnesium	2.50E-03	2.50E-03	2.50E-03				mg/L	4	0
		Manganese	5.42E+01	6.76E+01	5.96E+01				mg/L	4	1
		Mercury	6.79E-02	1.92E-01	1.36E-01				mg/L	4	4
		Nickel				2.00E-04	2.00E-04	2.00E-04	mg/L	4	0
		Potassium	2.66E+00	3.14E+00	2.95E+00				mg/L	4	0
		Selenium				1.50E-02	1.50E-02	1.50E-02	mg/L	4	0
		Silver				2.50E-03	2.50E-03	2.50E-03	mg/L	4	0
						5.00E-03	5.00E-03	5.00E-03	mg/L	4	0

Appendix A2. Ecological Risk Assessment Filtered Water Data Summary  
Port Sheridan Surplus Operable Unit Beach/Ravine BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Hits
Surface Water	Janes Ravine	Sodium	2.67E+01	2.17E+02	7.79E+01	2.50E-03	2.50E-03	2.50E-03	mg/L	4	4
		Thallium	.	.	.	1.00E-02	1.00E-02	1.00E-02	mg/L	4	0
		Vanadium	2.67E-02	2.67E-02	2.67E-02	2.00E-02	2.00E-02	2.00E-02	mg/L	4	1
		Zinc	4.98E-02	4.98E-02	4.98E-02	4.00E-02	4.00E-02	4.00E-02	mg/L	2	1
Surface Water	Janes Ravine Extra	Aluminum	.	.	.	5.00E-02	5.00E-02	5.00E-02	mg/L	2	0
		Antimony	3.46E-02	3.46E-02	3.46E-02	2.50E-02	2.50E-02	2.50E-02	mg/L	2	1
		Arsenic	5.01E-03	5.01E-03	5.01E-03	5.00E-03	5.00E-03	5.00E-03	mg/L	2	0
		Beryllium	3.21E+01	7.04E+01	5.13E+01	1.00E-02	1.00E-02	1.00E-02	mg/L	2	2
		Cadmium	.	.	.	2.00E-02	2.00E-02	2.00E-02	mg/L	2	0
		Chromium, total	2.49E-02	2.49E-02	2.49E-02	5.00E-03	5.00E-03	5.00E-03	mg/L	2	1
		Cobalt	6.44E-02	3.34E-01	1.99E-01	2.00E-03	2.00E-03	2.00E-03	mg/L	2	2
		Copper	4.10E-03	4.10E-03	4.10E-03	2.00E-03	2.00E-03	2.00E-03	mg/L	2	1
		Iron	1.41E+01	4.23E+01	2.82E+01	.	.	.	mg/L	2	2
		Lead	1.32E-02	1.49E-02	1.41E-02	2.00E-04	2.00E-04	2.00E-04	mg/L	2	2
		Magnesium	.	.	.	1.50E-02	1.50E-02	1.50E-02	mg/L	2	0
		Manganese	1.02E+00	2.99E+00	2.01E+00	2.50E-03	2.50E-03	2.50E-03	mg/L	2	2
		Nickel	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	2	0
		Potassium	1.05E+01	2.67E+01	1.86E+01	2.50E-03	2.50E-03	2.50E-03	mg/L	2	2
		Selenium	.	.	.	1.00E-02	1.00E-02	1.00E-02	mg/L	2	0
		Silver	.	.	.	.	.	.	mg/L	2	2
		Sodium	2.65E-02	3.96E-01	2.11E-01	.	.	.	mg/L	2	2
		Thallium	.	.	.	.	.	.	mg/L	2	0
		Vanadium	.	.	.	.	.	.	mg/L	2	0
		Zinc	.	.	.	.	.	.	mg/L	2	2

d:\mary\fisher2\surplusou\drft\fin\bchra\brs\filtered\ecofilt.lst  
c:\proj\sheridan\surplusou\beachrav\era2\append2\ecofilt.lst

## **Appendix A3**

Medium	Study Area	Analyte	Common Lab Contaminant?	Field Sample Data				Blank Data				
				Site ID	Lot	Date	Concentration	Units	Highest Blank Type	Highest Blank Concentration	Comparison Concentration *	Units
Sediment	Background Beach	Aluminum	No	BLDBSD01	MKKB	09/12/96	9.54E+02	mg/kg	Method	4.85E+02	2.43E+03	mg/kg
		Copper	No	BLDBSD01	MKKB	09/12/96	3.02E+00	mg/kg	Method	1.03E+00	5.15E+00	mg/kg
		Iron	No	BLDBSD01	MKKB	09/12/96	4.21E+03	mg/kg	Method	9.01E+02	4.51E+03	mg/kg
		Potassium	No	BLDBSD01	MKKB	09/12/96	1.38E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg
	Background Ravine	Aluminum	No	JRBSD05	MKKB	09/13/96	2.19E+03	mg/kg	Method	4.85E+02	2.43E+03	mg/kg
		Chlordane, gamma-	No	BGSD-2	RCMB	09/01/95	5.43E-03	mg/kg	Method	3.80E-03	1.90E-02	mg/kg
		Chlordane, gamma-	No	JRBSD04	RCEE	09/13/96	5.25E-03	mg/kg	Method	9.59E-03	4.80E-02	mg/kg
		Potassium	No	BGSD-4	XGWA	09/01/95	6.57E+02	mg/kg	Method	1.60E+02	8.00E+02	mg/kg
		Potassium	No	JRBSD04	MKKB	09/13/96	5.33E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg
		Potassium	No	JRBSD04	MKKB	09/13/96	6.13E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg
Beach	Beach	Aluminum	No	FTRSB01	VEFP	11/09/95	1.51E+03	mg/kg	Method	4.47E+02	2.24E+03	mg/kg
		Aluminum	No	FTRSB02	VEFP	11/09/95	1.28E+03	mg/kg	Method	4.47E+02	2.24E+03	mg/kg
		Aluminum	No	JRBSD06	MKKB	09/11/96	1.54E+03	mg/kg	Method	4.85E+02	2.43E+03	mg/kg
		Aluminum	No	LF2SB06D	UVC	01/13/91	2.60E+03	mg/kg	Method	1.05E+03	5.25E+03	mg/kg
		Aluminum	No	LF2SB08D	VXE	07/23/91	1.20E+03	mg/kg	Method	5.12E+02	2.56E+03	mg/kg
		Copper	No	FTRSB02	VEFP	11/09/95	3.90E+00	mg/kg	Method	8.21E-01	4.11E+00	mg/kg
		Fluoranthene	No	FTRSB02	QEVL	11/09/95	6.86E-01	mg/kg	Method	2.03E-03	1.02E-02	mg/kg
		Iron	No	LF2SB06D	UVC	01/13/91	8.50E+03	mg/kg	Method	2.32E+03	1.16E+04	mg/kg
		Iron	No	LF2SB08D	VXE	07/23/91	4.27E+03	mg/kg	Method	1.30E+03	6.50E+03	mg/kg
		Potassium	No	FTRSB01	VEFP	11/09/95	2.15E+02	mg/kg	Method	1.64E+02	8.20E+02	mg/kg
Hutchinson Ravine	Hutchinson Ravine	Potassium	No	FTRSB02	VEFP	11/09/95	1.53E+02	mg/kg	Method	1.64E+02	8.20E+02	mg/kg
		Potassium	No	JRBSD06	MKKB	09/11/96	2.18E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg
		Potassium	No	LF2SB06D	UVC	01/13/91	3.22E+02	mg/kg	Method	1.91E+02	9.55E+02	mg/kg
		Potassium	No	LF2SB08D	VXE	07/23/91	2.99E+02	mg/kg	Method	1.36E+02	6.80E+02	mg/kg
		Aluminum	No	HRBSD01	MKKB	09/11/96	2.03E+03	mg/kg	Method	4.85E+02	2.43E+03	mg/kg
		Aluminum	No	HRSD01	MKNA	02/21/96	3.21E+03	mg/kg	Method	1.32E+03	6.60E+03	mg/kg
		Aluminum	No	HRSD02	MKNA	02/21/96	4.50E+03	mg/kg	Method	1.32E+03	6.60E+03	mg/kg
		Aluminum	No	HRSD02	MKNA	02/21/96	4.93E+03	mg/kg	Method	1.32E+03	6.60E+03	mg/kg
		Aluminum	No	HRSD03	MKNA	02/22/96	5.65E+03	mg/kg	Method	1.32E+03	6.60E+03	mg/kg
		Chlordane, alpha-	No	HRSD01	RCXC	02/21/96	3.70E-03	mg/kg	Method	4.60E-03	2.30E-02	mg/kg
Hutchinson Ravine	Hutchinson Ravine	Chlordane, gamma-	No	HRSD01	RCXC	02/21/96	7.05E-03	mg/kg	Method	7.80E-03	3.90E-02	mg/kg
		Chromium, total	No	HRSD01	MKNA	02/21/96	6.73E+00	mg/kg	Method	1.89E+00	9.45E+00	mg/kg
		Chromium, total	No	HRSD02	MKNA	02/21/96	9.14E+00	mg/kg	Method	1.89E+00	9.45E+00	mg/kg
		Chromium, total	No	HRSD02	MKNA	02/21/96	9.31E+00	mg/kg	Method	1.89E+00	9.45E+00	mg/kg
		Potassium	No	HRBSD01	MKKB	09/11/96	4.02E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg
		Potassium	No	HRSD02	MKKB	09/10/96	5.36E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg
		Potassium	No	HRBSD04	MKKB	09/11/96	7.86E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg
		Potassium	No	HRBSD05	MKKB	09/10/96	6.68E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg
		Potassium	No	HRSD05	MKKB	09/10/96	7.59E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg
		Potassium	No	HRSD01	MKNA	02/21/96	6.55E+02	mg/kg	Method	3.31E+02	1.66E+03	mg/kg
Hutchinson Ravine	Hutchinson Ravine	Potassium	No	HRSD02	MKNA	02/21/96	8.81E+02	mg/kg	Method	3.31E+02	1.66E+03	mg/kg
		Potassium	No	HRSD02	MKNA	02/21/96	9.19E+02	mg/kg	Method	3.31E+02	1.66E+03	mg/kg
		Potassium	No	HRSD03	MKNA	02/22/96	8.62E+02	mg/kg	Method	3.31E+02	1.66E+03	mg/kg
		Vanadium	No	HRSD01	MKNA	02/21/96	1.36E+01	mg/kg	Method	4.37E+00	2.19E+01	mg/kg
		Vanadium	No	HRSD02	MKNA	02/21/96	1.52E+01	mg/kg	Method	4.37E+00	2.19E+01	mg/kg
		Vanadium	No	HRSD02	MKNA	02/21/96	1.54E+01	mg/kg	Method	4.37E+00	2.19E+01	mg/kg



Appendix A3. Blank Contamination Evaluation: Summary of Data Points to be Requalified (Page 2 of 2)

Medium	Study Area	Analyte	Common Lab				Field Sample Data				Blank Data			
			Contaminant?	Site ID	Lot	Date	Concentration	Units	Highest Blank Type	Highest Blank Concentration	Comparison Concentration*	Units		
Sediment	Janes Ravine	Vanadium	No	HRSD03	MKNA	02/22/96	1.80E+01	mg/kg	Method	4.37E+00	2.19E+01	mg/kg		
		Aluminum	No	JRBSD01	MKKB	09/11/96	1.49E+03	mg/kg	Method	4.85E+02	2.43E+03	mg/kg		
		Aluminum	No	JRSD02	MKNA	02/24/96	2.98E+03	mg/kg	Method	1.32E+03	6.60E+03	mg/kg		
		Chlordane, alpha-	No	JRBSD01	RCEE	09/11/96	7.77E-03	mg/kg	Method	5.20E-03	2.60E-02	mg/kg		
		Chlordane, alpha-	No	JRBSD02	RCEE	09/09/96	3.88E-03	mg/kg	Method	5.20E-03	2.60E-02	mg/kg		
		Chlordane, alpha-	No	JRSD02	RCZC	02/24/96	6.62E-03	mg/kg	Method	5.10E-03	2.55E-02	mg/kg		
		Chlordane, gamma-	No	JRBSD01	RCEE	09/11/96	8.12E-03	mg/kg	Method	9.59E-03	4.80E-02	mg/kg		
		Chlordane, gamma-	No	JRBSD02	RCEE	09/09/96	4.71E-03	mg/kg	Method	9.59E-03	4.80E-02	mg/kg		
		Chlordane, gamma-	No	JRSD02	RCZC	02/24/96	7.20E-03	mg/kg	Method	8.50E-03	4.25E-02	mg/kg		
		Chromium, total	No	JRSD02	MKNA	02/24/96	6.12E+00	mg/kg	Method	1.89E+00	9.45E+00	mg/kg		
		Methylnaphthalene, 2-	No	JRSD02	SKKA	02/24/96	3.36E-01	mg/kg	Method	1.41E-01	7.05E-01	mg/kg		
		Potassium	No	JRBSD01	MKKB	09/11/96	2.99E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg		
		Potassium	No	JRBSD02	MKKB	09/09/96	4.53E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg		
		Potassium	No	JRBSD03	MKKB	09/09/96	7.82E+02	mg/kg	Method	2.18E+02	1.09E+03	mg/kg		
		Potassium	No	JRSD02	MKNA	02/24/96	4.82E+02	mg/kg	Method	3.31E+02	1.66E+03	mg/kg		
		Vanadium	No	JRSD02	MKNA	02/24/96	1.45E+01	mg/kg	Method	4.37E+00	2.19E+01	mg/kg		
Surface Water	Background Ravine	Acetone	Yes	BGSW-1	NEUA	08/31/95	1.10E-02	mg/L	Method	2.30E-02	2.30E-01	mg/L		
		Acetone	Yes	BGSW-1	NEUA	08/31/95	2.00E-02	mg/L	Method	2.30E-02	2.30E-01	mg/L		
		Acetone	Yes	BGSW-2	NEUA	08/31/95	1.00E-02	mg/L	Method	2.30E-02	2.30E-01	mg/L		
		Acetone	Yes	BGSW-3	NEUA	08/30/95	1.80E-02	mg/L	Method	2.30E-02	2.30E-01	mg/L		
		Acetone	Yes	BGSW-4	NEUA	08/30/95	1.10E-02	mg/L	Method	2.30E-02	2.30E-01	mg/L		
		Aluminum	No	BGSW-1	MHMA	08/31/95	5.89E-02	mg/L	Rinse	4.92E-02	2.46E-01	mg/L		
		Bis(2-ethylhexyl) phthalate	Yes	BGSW-1	VFBB	08/31/95	4.90E-03	mg/L	Method	7.50E-03	7.50E-02	mg/L		
		Bis(2-ethylhexyl) phthalate	Yes	BGSW-1	VFBB	08/31/95	5.40E-02	mg/L	Method	7.50E-03	7.50E-02	mg/L		
		Bis(2-ethylhexyl) phthalate	Yes	BGSW-2	VFBB	08/31/95	7.40E-03	mg/L	Method	7.50E-03	7.50E-02	mg/L		
		Bis(2-ethylhexyl) phthalate	Yes	BGSW-3	VFBB	08/30/95	2.80E-03	mg/L	Method	7.50E-03	7.50E-02	mg/L		
		Bis(2-ethylhexyl) phthalate	Yes	BGSW-4	VFBB	08/30/95	3.40E-03	mg/L	Method	7.50E-03	7.50E-02	mg/L		
		Bis(2-ethylhexyl) phthalate	Yes	BGSW-5	VFBB	08/31/95	1.10E-02	mg/L	Method	7.50E-03	7.50E-02	mg/L		
		Dinitrotoluene, 3,4-	No	BGSW-1	PEUL	08/31/95	5.50E-03	mg/L	Rinse	5.92E-03	2.96E-02	mg/L		
		Dinitrotoluene, 3,4-	No	BGSW-1	PEUL	08/31/95	5.55E-03	mg/L	Rinse	5.92E-03	2.96E-02	mg/L		
		Dinitrotoluene, 3,4-	No	BGSW-2	PEUL	08/31/95	5.74E-03	mg/L	Rinse	5.92E-03	2.96E-02	mg/L		
		Dinitrotoluene, 3,4-	No	BGSW-5	PEUL	08/31/95	5.28E-03	mg/L	Rinse	5.92E-03	2.96E-02	mg/L		
Hutchinson Ravine	Acetone	Yes	HRSW02	NEUB	02/21/96	7.90E-02	mg/L	Rinse	1.40E-02	1.40E-01	mg/L			
	Aluminum	No	HRSW01	MHEB	02/21/96	1.78E-01	mg/L	Rinse	4.14E-02	2.07E-01	mg/L			
	Aluminum	No	HRSW02	MHEB	02/21/96	5.77E-02	mg/L	Rinse	4.14E-02	2.07E-01	mg/L			
	Boron	No	HRBSW04	MHDC	09/12/96	1.70E-01	mg/L	Rinse	6.53E-02	3.27E-01	mg/L			

\* Comparison concentration = 10 times the blank concentration if a common lab contaminant; 5 times if not.

Source: QST, 1997.

## **Appendix B**

### **Data Summary**

## **Appendix B1**

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 1

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Background Beach	Acenaphthene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Acenaphthylene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Aldrin	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Aluminum	.	.	.	4.77E+02	4.77E+02	4.77E+02	mg/kg	1	0
		Amino-2,6-dinitrotoluene, 4-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Amino-4,6-dinitrotoluene, 2-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Anthracene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Antimony	2.26E+00	2.26E+00	2.26E+00	2.50E+00	2.50E+00	2.50E+00	mg/kg	1	0
		Arsenic	.	.	.	2.00E+01	2.00E+01	2.00E+01	mg/kg	1	1
		Barium	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Benzo(a)anthracene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Benzo(a)pyrene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Benzo(b)fluoranthene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Benzo(ghi)perylene	.	.	.	8.00E-02	8.00E-02	8.00E-02	mg/kg	1	0
		Benzo(k)fluoranthene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Benzoic acid	.	.	.	7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Benzyl alcohol	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Beryllium	.	.	.	1.00E-01	1.00E-01	1.00E-01	mg/kg	1	0
		Bis(2-chloroethoxy) methane	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Bis(2-chloroethyl) ether	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Bis(2-chloroisopropyl) ether	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Bis(2-ethylhexyl) phthalate	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Bromophenyl phenyl ether, 4-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Butylbenzyl phthalate	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Cadmium	3.48E+04	3.48E+04	3.48E+04	2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Calcium	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	1
		Carbazole	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Chlordane, alpha-	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Chlordane, gamma-	.	.	.	1.00E-02	1.00E-02	1.00E-02	mg/kg	1	0
		Chlordane, total	.	.	.	1.00E-02	1.00E-02	1.00E-02	mg/kg	1	0
		Chloro-3-methylphenol, 4-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Chloroaniline, 4-	.	.	.	1.50E-01	1.50E-01	1.50E-01	mg/kg	1	0
		Chloronaphthalene, 2-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Chlorophenol, 2-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Chlorophenyl phenyl ether, 4-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Chromium, total	2.70E+00	2.70E+00	2.70E+00	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	1
		Chrysene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Cobalt	.	.	.	1.00E+00	1.00E+00	1.00E+00	mg/kg	1	0
		Copper	.	.	.	1.51E+00	1.51E+00	1.51E+00	mg/kg	1	0
		Cyanide, total	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		DDD, P,p'-	4.38E-03	4.38E-03	4.38E-03	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	1
		DDE, P,p'-	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		DDT, P,p'-	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Di-n-butyl phthalate	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Di-n-octyl phthalate	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Dibenz(ah)anthracene	.	.	.	8.00E-02	8.00E-02	8.00E-02	mg/kg	1	0
		Dibenzofuran	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Dichlorobenzene, 1,2-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Dichlorobenzene, 1,3-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Dichlorobenzene, 1,4-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Dichlorobenzidine, 3,3'-	.	.	.	3.35E-01	3.35E-01	3.35E-01	mg/kg	1	0
		Dichlorophenol, 2,4-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Dieldrin	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Diethyl phthalate	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Dimethyl phthalate	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Dimethylphenol, 2,4-	.	.	.	7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Dinitro-2-methylphenol, 4,6-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Dinitrobenzene, 1,3-	.	.	.	7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Dinitrophenol, 2,4-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Dinitrotoluene, 2,4-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Dinitrotoluene, 2,6-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Endosulfan A	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Endosulfan B	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0

d:\mary\ftsher2\surplou\drftfin\bcrravs\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Background Beach	Endosulfan sulfate	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Endrin	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Endrin aldehyde	.	.	.	1.10E-02	1.10E-02	1.10E-02	mg/kg	1	0
		Endrin ketone	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Fluoranthene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Fluorene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		HMX	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Heptachlor	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Heptachlor epoxide	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Hexachlorobenzene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Hexachlorobutadiene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Hexachlorocyclohexane, alpha-	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Hexachlorocyclohexane, beta-	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Hexachlorocyclohexane, delta-	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Hexachlorocyclohexane, gamma-	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Hexachlorocyclopentadiene	.	.	.	5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Hexachloroethane	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Indeno(1,2,3-cd)pyrene	.	.	.	8.00E-02	8.00E-02	8.00E-02	mg/kg	1	0
		Iron	.	.	.	2.11E+03	2.11E+03	2.11E+03	mg/kg	1	0
		Isophorone	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Lead	3.72E+00	3.72E+00	3.72E+00	.	.	.	mg/kg	1	1
		Magnesium	1.79E+04	1.79E+04	1.79E+04	.	.	.	mg/kg	1	1
		Manganese	2.26E+02	2.26E+02	2.26E+02	.	.	.	mg/kg	1	1
		Mercury	.	.	.	5.00E-02	5.00E-02	5.00E-02	mg/kg	1	0
		Methoxychlor	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Methylnaphthalene, 2-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Methylphenol, 2-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Methylphenol, 4-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Naphthalene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nickel	3.93E+00	3.93E+00	3.93E+00	.	.	.	mg/kg	1	1
		Nitroaniline, 2-	.	.	.	3.35E-01	3.35E-01	3.35E-01	mg/kg	1	0
		Nitroaniline, 3-	.	.	.	3.35E-01	3.35E-01	3.35E-01	mg/kg	1	0
		Nitroaniline, 4-	.	.	.	3.35E-01	3.35E-01	3.35E-01	mg/kg	1	0
		Nitrobenzene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nitrophenol, 2-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nitrophenol, 4-	.	.	.	7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Nitrosodi-N-propylamine, N-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nitrosodiphenylamine, N-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nitrotoluene, 2-	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Nitrotoluene, 3-	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Nitrotoluene, 4-	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Organic carbon, total (TOC)	1.93E+04	1.93E+04	1.93E+04	.	.	.	mg/kg	1	1
		PCB 1016	.	.	.	6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1221	.	.	.	6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1232	.	.	.	6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1242	.	.	.	6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1248	.	.	.	6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1254	.	.	.	6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1260	.	.	.	6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		Pentachlorophenol	.	.	.	3.35E-01	3.35E-01	3.35E-01	mg/kg	1	0
		Phenanthrene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Phenol	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Potassium	.	.	.	6.90E+01	6.90E+01	6.90E+01	mg/kg	1	0
		Pyrene	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		RDX	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Selenium	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Silver	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Sodium	4.28E+02	4.28E+02	4.28E+02	.	.	.	mg/kg	1	1
		Tetralin	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Thallium	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Toxaphene	.	.	.	1.50E-01	1.50E-01	1.50E-01	mg/kg	1	0
		Trichlorobenzene, 1,2,4-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Trichlorophenol, 2,4,5-	.	.	.	1.50E-01	1.50E-01	1.50E-01	mg/kg	1	1

d:\mary\fisher2\surplous\drftfinl\bchra\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 3

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Background Beach	Trichlorophenol, 2,4,6-	.	.	.	1.50E-01	1.50E-01	1.50E-01	mg/kg	1	0
		Trinitrobenzene, 1,3,5-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Trinitrotoluene, 2,4,6-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Vanadium	4.22E+00	4.22E+00	4.22E+00	.	.	.	mg/kg	1	1
		Zinc	1.70E+01	1.70E+01	1.70E+01	.	.	.	mg/kg	1	1
Sediment	Background Ravine	2,4,5-T	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		2,4-D	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		2,4-DB	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Acenaphthene	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Acenaphthylene	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Acetone	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Aldrin	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Aluminum	2.58E+03	8.47E+03	5.30E+03	.	.	.	mg/kg	5	5
		Amino-2,6-dinitrotoluene, 4-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	5	0
		Amino-4,6-dinitrotoluene, 2-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	5	0
		Anthracene	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Antimony	.	.	.	2.50E+00	2.50E+00	2.50E+00	mg/kg	5	0
		Arsenic	7.00E+00	1.40E+01	1.02E+01	.	.	.	mg/kg	5	5
		Barium	2.00E+00	2.00E+00	2.00E+00	1.99E+01	1.99E+01	1.99E+01	mg/kg	5	2
		Benz(a)anthracene	3.96E+01	4.91E+01	4.91E+01	7.00E-02	3.50E-01	1.40E-01	mg/kg	5	1
		Benzene	2.00E+00	2.00E+00	2.00E+00	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Benzo(a)pyrene	2.00E+00	2.00E+00	2.00E+00	7.00E-02	3.50E-01	1.40E-01	mg/kg	5	1
		Benzo(b)fluoranthene	2.00E+00	2.00E+00	2.00E+00	7.00E-02	3.50E-01	1.40E-01	mg/kg	5	1
		Benzo(ghi)perylene	1.00E+00	1.00E+00	1.00E+00	8.00E-02	4.00E-01	1.60E-01	mg/kg	5	1
		Benzo(k)fluoranthene	1.00E+00	1.00E+00	1.00E+00	7.00E-02	3.50E-01	1.40E-01	mg/kg	5	1
		Benzoic acid	.	.	.	7.00E-01	3.50E+00	1.82E+00	mg/kg	5	0
		Benzyl alcohol	7.56E-01	7.56E-01	7.56E-01	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Beryllium	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	5	1
		Bis(2-chloroethoxy) methane	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Bis(2-chloroethyl) ether	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Bis(2-chloroisopropyl) ether	1.90E-01	2.00E+00	7.13E-01	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Bis(2-ethylhexyl) phthalate	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	4
		Bromodichloromethane	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Bromoforn	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Bromomethane	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Bromophenyl phenyl ether, 4-	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Butylbenzyl phthalate	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Cadmium	3.78E+04	7.36E+04	5.73E+04	2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Calcium	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	5
		Carbazole	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Carbon disulfide	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Carbon tetrachloride	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chlordane, alpha-	6.55E-03	6.55E-03	6.55E-03	1.50E-03	1.50E-03	1.50E-03	mg/kg	5	1
		Chlordane, gamma-	5.95E-03	6.25E-03	6.25E-03	1.50E-03	1.50E-03	1.50E-03	mg/kg	5	2
		Chlordane, total	2.49E-02	5.24E-02	3.87E-02	1.00E-02	1.00E-02	1.00E-02	mg/kg	5	2
		Chloro-3-methylphenol, 4-	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Chloroaniline, 4-	.	.	.	1.50E-01	1.00E+00	4.90E-01	mg/kg	5	0
		Chlorobenzene	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chloroethane	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chloroethylvinyl ether, 2-	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chloroform	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chloromethane	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chloronaphthalene, 2-	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Chlorophenol, 2-	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Chlorophenyl phenyl ether, 4-	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Chromium, total	6.42E+00	1.30E+01	9.46E+00	.	.	.	mg/kg	5	5
		Chrysene	2.00E+00	2.00E+00	2.00E+00	7.00E-02	3.50E-01	1.40E-01	mg/kg	5	1
		Cobalt	4.92E+00	1.02E+01	7.74E+00	.	.	.	mg/kg	5	5
		Copper	9.26E+00	1.83E+01	1.49E+01	.	.	.	mg/kg	5	5

d:\mary\fisher2\surplous\drftfin\bcbrava\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Defects
Sediment	Background Ravine	Cyanide, total				1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		DDD, P,p'-	1.52E-02	2.60E-01	1.04E-01				mg/kg	5	5
		DDE, P,p'-	3.63E-03	6.52E-02	2.97E-02				mg/kg	5	5
		DDT, P,p'-	9.03E-03	5.41E-02	3.67E-02				mg/kg	5	5
		Dalepon				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Di-n-butyl phthalate				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Di-n-octyl phthalate				8.00E-02	4.00E-01	2.08E-01	mg/kg	5	0
		Dibenz(ah)anthracene				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dibenzofuran				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dibromochloromethane				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dicamba				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dichlorobenzene, 1,2-				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dichlorobenzene, 1,3-				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dichlorobenzene, 1,4-				3.35E-01	1.50E+00	8.01E-01	mg/kg	5	0
		Dichlorobenzidine, 3,3'-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloroethane, 1,1-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloroethane, 1,2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloroethene, 1,1-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloroethene, 1,2-, total				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichlorophenol, 2,4-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloropropane, 1,2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloropropene, 1,3-, cis-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloropropene, 1,3-, trans-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloroprop				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dieldrin				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Diethyl phthalate				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dimethyl phthalate				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dimethylphenol, 2,4-				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dinitro-2-methylphenol, 4,6-				7.00E-01	3.50E+00	1.25E+00	mg/kg	5	0
		Dinitrobenzene, 1,3-				1.25E-01	1.25E+00	1.25E+00	mg/kg	5	0
		Dinitrophenol, 2,4-				7.00E-01	3.50E+00	1.82E+00	mg/kg	5	0
		Dinitrotoluene, 2,4-				7.00E-02	1.00E-01	8.20E-02	mg/kg	5	0
		Dinitrotoluene, 2,6-				7.00E-02	1.00E-01	8.20E-02	mg/kg	5	0
		Dinitrotoluene, 3,4-	4.20E+00	4.46E+00	4.32E+00				mg/kg	5	5
		Dinoseb				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Endosulfan A				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Endosulfan B				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Endosulfan sulfate				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Endrin				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Endrin aldehyde				1.10E-02	1.10E-02	1.10E-02	mg/kg	5	0
		Endrin ketone				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Ethylbenzene				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Fluoranthene				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	2
		Fluorene	2.00E+00	5.00E+00	3.50E+00				mg/kg	5	0
		HMX				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Heptachlor				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Heptachlor epoxide				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Hexachlorobenzene	8.68E-03	8.68E-03	8.68E-03	1.50E-03	1.50E-03	1.50E-03	mg/kg	5	1
		Hexachlorobutadiene				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Hexachlorocyclohexane, alpha-				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Hexachlorocyclohexane, beta-				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Hexachlorocyclohexane, delta-				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Hexachlorocyclohexane, gamma-	(Lindane)	7.60E-03	7.60E-03	5.00E-01	2.50E+00	1.30E+00	mg/kg	5	1
		Hexachlorocyclopentadiene				5.00E-01	2.50E+00	1.82E-01	mg/kg	5	0
		Hexachlorocyclopentadiene				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Indeno(1,2,3-cd)pyrene				8.00E-02	4.00E-01	1.60E-01	mg/kg	5	1
		Iron	1.00E+00	1.00E+00	1.00E+00				mg/kg	5	5
		Isophorone	1.01E+04	1.84E+04	1.43E+04				mg/kg	5	0
		Lead	8.03E+00	4.30E+01	1.86E+01				mg/kg	5	5
		MCFA				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
						1.00E-01	1.00E-01	1.00E-01	mg/kg	5	0

d:\mary\fisher2\surplou\drftfin\l\bchra\datasumm\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BBA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Defects
Sediment	Background Ravine	MCCP	2.48E+04	4.48E+04	3.45E+04	1.00E-01	1.00E-01	1.00E-01	mg/kg	5	0
		Magnesium	4.69E+02	8.87E+02	6.06E+02	5.00E-02	5.00E-02	5.00E-02	mg/kg	5	5
		Manganese				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Mercury				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Methoxychlor				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Methyl ethyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Methyl isobutyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Methyl n-butyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Methylene chloride				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Methylnaphthalene, 2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Methylphenol, 2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Methylphenol, 4-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Naphthalene				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Nickel	9.85E+00	2.09E+01	1.63E+01	3.35E-01	3.35E-01	3.35E-01	mg/kg	5	5
		Nitroaniline, 2-				3.35E-01	3.35E-01	3.35E-01	mg/kg	5	0
		Nitroaniline, 3-				3.35E-01	3.35E-01	3.35E-01	mg/kg	5	0
		Nitroaniline, 4-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Nitrobenzene				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Nitrophenol, 2-				7.00E-01	7.00E-01	7.00E-01	mg/kg	5	0
		Nitrophenol, 4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	5	0
		Nitrosodi-N-propylamine, N-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Nitrosodiphenylamine, N-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Nitrotoluene, 2-				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Nitrotoluene, 3-				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Nitrotoluene, 4-				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Organic carbon, total (TOC)	2.45E+04	2.45E+04	2.45E+04	6.50E-03	6.50E-03	6.50E-03	mg/kg	1	1
		PCB 1016				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1221				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1232				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1242				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1248				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1254				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1260				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		Pentachlorophenol				3.35E-01	3.35E-01	3.35E-01	mg/kg	5	0
		Petroleum hydrocarbons, total (TPH)	5.39E+01	7.82E+01	6.21E+01	1.38E+01	1.38E+01	1.38E+01	mg/kg	5	3
		Phenanthrene	2.00E+00	4.00E+00	3.00E+00	7.00E-02	7.00E-02	7.00E-02	mg/kg	5	2
		Phenol				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Potassium	8.39E+02	1.83E+03	1.26E+03	3.29E+02	3.29E+02	3.29E+02	mg/kg	5	4
		Pyrene	2.00E+00	4.00E+00	3.00E+00	7.00E-02	7.00E-02	7.00E-02	mg/kg	5	2
		RDX				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Selenium				1.25E-01	1.25E-01	1.25E-01	mg/kg	5	0
		Silver				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Silvex (2,4,5-TP)				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Sodium	4.10E+02	5.08E+02	4.66E+02	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	5
		Styrene				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Tetrachloroethane, 1,1,2,2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Tetrachloroethene				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Tetryl				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Thallium	3.76E-01	1.39E+00	8.07E-01	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	5
		Toluene				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Toxaphene				1.50E-01	1.50E-01	1.50E-01	mg/kg	5	0
		Trichlorobenzene, 1,2,4-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Trichloroethane, 1,1,1-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Trichloroethane, 1,1,2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Trichloroethene				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Trichlorophenol, 2,4,5-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Trichlorophenol, 2,4,6-				1.50E-01	1.50E-01	1.50E-01	mg/kg	5	0
		Trinitrotoluene, 2,4,6-				1.50E-01	1.50E-01	1.50E-01	mg/kg	5	0
		Vanadium	1.07E+01	2.35E+01	1.80E+01	1.25E-01	1.25E-01	1.25E-01	mg/kg	5	5
		Vinyl acetate				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Vinyl chloride				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Xylenes, total	3.05E+01	5.35E+01	3.94E+01	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Zinc				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	5

d:\mary\ftsher2\surpl\ou\drft\fin\l\bchra\datasum\humdasum.lst



Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Beach	2,4-D	2.39E-01	2.39E-01	2.39E-01	8.85E-03	8.85E-03	8.85E-03	mg/kg	1	0
		Acenaphthene	2.39E-01	2.39E-01	2.39E-01	1.80E-02	7.00E-02	3.78E-02	mg/kg	11	1
		Acenaphthylene				1.65E-02	7.00E-02	3.95E-02	mg/kg	11	0
		Acetone				8.50E-03	8.50E-03	8.50E-03	mg/kg	6	0
		Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/kg	6	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/kg	6	0
		Aldrin				1.50E-01	1.50E-01	1.50E-01	mg/kg	7	0
		Aluminum	1.43E+03	6.40E+03	2.70E+03	6.00E+02	1.30E+03	8.13E+02	mg/kg	11	6
		Amino-2,6-dinitrotoluene, 4-				1.25E-01	1.25E-01	1.25E-01	mg/kg	3	0
		Amino-4,6-dinitrotoluene, 2-				1.25E-01	1.25E-01	1.25E-01	mg/kg	3	0
		Anthracene				3.35E-03	7.00E-02	1.66E-02	mg/kg	11	0
		Antimony	6.90E+00	1.78E+01	1.24E+01	1.90E+00	2.50E+00	2.17E+00	mg/kg	11	2
		Arsenic	2.79E+00	1.31E+01	5.28E+00				mg/kg	11	11
		Barium				1.48E+01	2.00E+01	1.72E+01	mg/kg	11	0
		Benz(a)anthracene	1.88E-03	6.11E-03	3.23E-03	7.00E-02	8.50E-02	8.29E-02	mg/kg	11	4
		Benzene				7.50E-04	7.50E-04	7.50E-04	mg/kg	6	0
		Benzidine				4.25E-01	4.25E-01	4.25E-01	mg/kg	6	0
		Benzo(a)pyrene	1.72E-03	7.21E-03	3.66E-03	7.00E-02	1.25E-01	1.17E-01	mg/kg	11	4
		Benzo(b)fluoranthene	2.71E-03	8.01E-03	4.70E-03	1.05E-02	1.05E-01	1.00E-01	mg/kg	11	4
		Benzo(ghi)perylene	9.31E-03	9.31E-03	9.31E-03	3.35E-03	1.25E-01	8.40E-02	mg/kg	11	1
		Benzo(k)fluoranthene	1.05E-03	4.14E-03	2.21E-03	3.30E-02	7.00E-02	3.83E-02	mg/kg	11	4
		Benzoic acid				7.00E-01	3.05E+00	2.71E+00	mg/kg	7	0
		Benzyl alcohol				7.00E-02	9.50E-02	9.14E-02	mg/kg	7	0
		Beryllium	3.41E-01	3.41E-01	3.41E-01	1.00E-01	9.30E-01	5.98E-01	mg/kg	11	1
		Bis(2-chloroethoxy) methane				2.95E-02	7.00E-02	3.53E-02	mg/kg	7	0
		Bis(2-chloroethyl) ether				1.65E-02	7.00E-02	2.41E-02	mg/kg	7	0
		Bis(2-chloroisopropyl) ether				7.00E-02	1.00E-01	9.57E-02	mg/kg	7	0
		Bis(2-ethylhexyl) phthalate				7.00E-02	3.10E-01	2.76E-01	mg/kg	7	0
		Bromodichloromethane				1.45E-03	1.45E-03	1.45E-03	mg/kg	6	0
		Bromoform				3.45E-03	3.45E-03	3.45E-03	mg/kg	6	0
		Bromomethane				2.85E-03	2.85E-03	2.85E-03	mg/kg	6	0
		Bromophenyl phenyl ether, 4-				1.65E-02	7.00E-02	2.41E-02	mg/kg	7	0
		Butylbenzyl phthalate				7.00E-02	8.50E-02	8.29E-02	mg/kg	7	0
		Cadmium	3.76E+04	1.20E+05	7.19E+04	2.50E-01	1.53E+00	9.45E-01	mg/kg	11	11
		Calcium				7.00E-02	7.00E-02	7.00E-02	mg/kg	11	0
		Carbazole				2.20E-03	2.20E-03	2.20E-03	mg/kg	6	0
		Carbon disulfide				3.50E-03	3.50E-03	3.50E-03	mg/kg	6	0
		Carbon tetrachloride				1.50E-03	1.50E-03	1.42E-01	mg/kg	7	0
		Chlordane, alpha-				1.50E-03	1.50E-03	1.42E-01	mg/kg	7	0
		Chlordane, gamma-				1.00E-02	1.00E-02	1.00E-02	mg/kg	2	1
		Chlordane, total				4.75E-02	7.00E-02	5.07E-02	mg/kg	7	0
		Chloro-3-methylphenol, 4-				1.50E-01	4.05E-01	3.69E-01	mg/kg	7	0
		Chloroaniline, 4-				4.30E-04	4.30E-04	4.30E-04	mg/kg	6	0
		Chlorobenzene				6.00E-03	6.00E-03	6.00E-03	mg/kg	6	0
		Chloroethane				5.00E-03	5.00E-03	5.00E-03	mg/kg	6	0
		Chloroethylvinyl ether, 2-				4.35E-04	4.35E-04	4.35E-04	mg/kg	6	0
		Chloroform				4.40E-03	4.40E-03	4.40E-03	mg/kg	6	0
		Chloromethane				1.80E-02	7.00E-02	2.54E-02	mg/kg	7	0
		Chloronaphthalene, 2-				3.00E-02	7.00E-02	3.57E-02	mg/kg	7	0
		Chlorophenol, 2-				1.65E-02	7.00E-02	2.41E-02	mg/kg	7	0
		Chlorophenyl phenyl ether, 4-				6.35E+00	6.35E+00	6.35E+00	mg/kg	11	5
		Chromium, total	4.08E+00	4.68E+00	4.39E+00	1.36E-02	3.35E-03	4.40E-02	mg/kg	11	1
		Chrysene	1.36E-02	1.36E-02	1.36E-02	1.00E+00	7.00E-02	5.88E+00	mg/kg	11	3
		Cobalt	2.02E+00	3.51E+00	2.55E+00	1.95E+00	2.93E+01	2.54E+01	mg/kg	11	4
		Copper	5.55E+00	8.06E+00	6.93E+00	1.25E-01	4.60E-01	4.12E-01	mg/kg	7	0
		Cyanide, total				1.35E-01	1.35E-01	1.35E-01	mg/kg	7	2
		DDD, P,p'-	9.66E-03	4.30E-01	2.20E-01	1.50E-03	1.55E-01	1.29E-01	mg/kg	7	1
		DDE, P,p'-	3.50E-02	3.50E-02	3.50E-02	1.50E-03	1.55E-01	1.29E-01	mg/kg	7	1
		DDT, P,p'-	9.80E-02	9.80E-02	9.80E-02	3.05E-02	7.00E-02	3.61E-02	mg/kg	7	0
		Di-n-butyl phthalate				7.00E-02	9.50E-02	9.14E-02	mg/kg	7	0
		Di-n-octyl phthalate				1.65E-03	1.05E-01	6.51E-02	mg/kg	11	0
		Dibenz(ah)anthracene				1.75E-02	7.00E-02	2.50E-02	mg/kg	7	0
		Dibenzofuran							mg/kg	7	0

d:\mary\ftsher2\surplsou\drftfinl\bchravs\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Beach	Dibromochloromethane				1.55E-03	1.55E-03	1.55E-03	mg/kg	6	0
		Dichlorobenzene, 1,2-				5.50E-02	7.00E-02	5.71E-02	mg/kg	7	0
		Dichlorobenzene, 1,3-				6.50E-02	7.00E-02	6.57E-02	mg/kg	7	0
		Dichlorobenzene, 1,4-				4.90E-02	7.00E-02	5.20E-02	mg/kg	7	0
		Dichlorobenzenes, total				5.00E-02	5.00E-02	5.00E-02	mg/kg	6	0
		Dichlorobenzidine, 3,3'-				3.35E-01	3.15E+00	2.75E+00	mg/kg	7	0
		Dichloroethane, 1,1-				1.15E-03	1.15E-03	1.15E-03	mg/kg	6	0
		Dichloroethane, 1,2-				8.50E-04	8.50E-04	8.50E-04	mg/kg	6	0
		Dichloroethene, 1,1-				1.95E-03	1.95E-03	1.95E-03	mg/kg	6	0
		Dichloroethenes, 1,2-, total				1.50E-03	1.50E-03	1.50E-03	mg/kg	6	0
		Dichlorophenol, 2,4-				7.00E-02	9.00E-02	8.71E-02	mg/kg	7	0
		Dichloropropane, 1,2-				1.45E-03	1.45E-03	1.45E-03	mg/kg	6	0
		Dichloropropene, 1,3-, cis-				1.60E-03	1.60E-03	1.60E-03	mg/kg	6	0
		Dichloropropene, 1,3-, trans-				1.40E-03	1.40E-03	1.40E-03	mg/kg	6	0
		Dieldrin				1.50E-03	1.55E-01	1.11E-01	mg/kg	7	0
		Diethyl phthalate				7.00E-02	1.20E-01	1.13E-01	mg/kg	7	0
		Dimethyl phthalate				7.00E-02	8.50E-02	8.29E-02	mg/kg	7	0
		Dimethylphenol, 2,4-				7.00E-02	3.45E-01	3.06E-01	mg/kg	7	0
		Dinitro-2-methylphenol, 4,6-				2.75E-01	7.00E-01	3.36E-01	mg/kg	7	0
		Dinitrobenzene, 1,3-	2.97E-01	2.97E-01	2.97E-01	1.25E-01	2.48E-01	2.13E-01	mg/kg	8	1
		Dinitrophenol, 2,4-				6.00E-01	7.00E-01	6.14E-01	mg/kg	7	0
		Dinitrotoluene, 2,4-				7.00E-02	1.00E-01	7.67E-02	mg/kg	9	0
		Dinitrotoluene, 3,4-				4.25E-02	1.00E-01	5.83E-02	mg/kg	9	0
		Diphenylhydrazine, 1,2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	2	2
		Endosulfan A				7.00E-02	7.00E-02	7.00E-02	mg/kg	6	0
		Endosulfan B				1.50E-03	3.10E-01	2.22E-01	mg/kg	7	0
		Endosulfan sulfate				1.50E-03	3.10E-01	2.22E-01	mg/kg	7	0
		Endrin				1.50E-03	3.10E-01	2.22E-01	mg/kg	7	0
		Endrin aldehyde				1.50E-03	2.25E-01	1.61E-01	mg/kg	7	0
		Endrin ketone				1.10E-02	2.65E-01	1.93E-01	mg/kg	7	0
		Ethylbenzene				1.50E-03	2.65E-01	2.27E-01	mg/kg	7	0
		Fluoranthene				8.50E-04	8.50E-04	8.50E-04	mg/kg	6	0
		Fluorene	4.73E-03	1.65E-02	1.01E-02	3.43E-03	7.00E-02	3.47E-02	mg/kg	11	3
		HMX				1.65E-02	7.00E-02	2.14E-02	mg/kg	11	0
		Heptachlor				2.50E-01	3.33E-01	3.02E-01	mg/kg	8	0
		Heptachlor epoxide				1.50E-03	6.50E-02	4.71E-02	mg/kg	7	0
		Hexachlorobenzene				1.50E-03	1.65E-01	1.19E-01	mg/kg	7	0
		Hexachlorobutadiene				1.65E-02	7.00E-02	2.41E-02	mg/kg	7	0
		Hexachlorocyclohexane, alpha-				7.00E-02	1.15E-01	1.09E-01	mg/kg	7	0
		Hexachlorocyclohexane, beta-				1.50E-03	1.35E-01	9.73E-02	mg/kg	7	0
		Hexachlorocyclohexane, delta-				1.29E-03	1.35E-01	9.68E-02	mg/kg	7	0
		Hexachlorocyclohexane, gamma-				1.50E-03	1.35E-01	9.70E-02	mg/kg	7	0
		Hexachlorocyclopentadiene				1.50E-03	1.35E-01	1.13E-01	mg/kg	7	1
		Indeno(1,2,3-cd)pyrene				5.00E-01	3.10E+00	2.73E+00	mg/kg	7	0
		Iron	3.92E-03	4.60E-03	4.26E-03	1.65E-03	1.45E-01	1.06E-01	mg/kg	11	2
		Isodrin	5.69E+03	1.30E+04	8.46E+03	2.14E+03	4.25E+03	3.19E+03	mg/kg	11	9
		Isophorone				2.31E-03	2.31E-03	2.31E-03	mg/kg	1	0
		Lead	3.59E+00	1.46E+01	7.85E+00	1.65E-02	7.00E-02	2.41E-02	mg/kg	7	0
		Magnesium	2.09E+04	5.40E+04	3.68E+04	3.31E+00	3.31E+00	3.31E+00	mg/kg	11	9
		Manganese	2.14E+02	6.27E+02	3.94E+02				mg/kg	11	11
		Mercury				2.50E-02	5.00E-02	3.64E-02	mg/kg	11	0
		Methoxychlor				1.50E-03	1.65E-01	1.23E-01	mg/kg	7	0
		Methyl ethyl ketone				3.50E-02	3.50E-02	3.50E-02	mg/kg	6	0
		Methyl isobutyl ketone				1.35E-02	1.35E-02	1.35E-02	mg/kg	6	0
		Methyl n-butyl ketone				1.60E-02	1.60E-02	1.60E-02	mg/kg	6	0
		Methylene chloride				6.00E-03	6.00E-03	6.00E-03	mg/kg	6	0
		Methylnaphthalene, 1-				6.65E-02	6.65E-02	6.65E-02	mg/kg	4	0
		Methylnaphthalene, 2-	1.43E-01	1.43E-01	1.43E-01	7.00E-02	7.00E-02	4.17E-02	mg/kg	11	1
		Methylphenol, 2-				1.45E-02	7.00E-02	2.24E-02	mg/kg	7	0
		Methylphenol, 4-				7.00E-02	1.20E-01	1.13E-01	mg/kg	7	0
		Naphthalene				1.85E-02	7.00E-02	4.06E-02	mg/kg	11	0

d:\mary\ftsher2\surplusou\drftfin\bchravs\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Beach	Nickel	4.63E+00	2.78E+01	9.07E+00	6.30E+00	6.30E+00	6.30E+00	mg/kg	11	6
		Nitroaniline, 2-				3.10E-02	3.35E-01	7.44E-02	mg/kg	7	0
		Nitroaniline, 3-				2.25E-01	3.35E-01	2.41E-01	mg/kg	7	0
		Nitroaniline, 4-				2.05E-01	3.35E-01	2.24E-01	mg/kg	7	0
		Nitrobenzene				2.25E-02	1.25E-01	5.06E-02	mg/kg	9	0
		Nitroglycerine				2.00E+00	2.00E+00	2.00E+00	mg/kg	5	0
		Nitrophenol, 2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	7	0
		Nitrophenol, 4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	7	0
		Nitrosodi-N-propylamine, N-				7.00E-02	1.00E-01	9.57E-02	mg/kg	7	0
		Nitrosodimethylamine, N-				7.00E-02	7.00E-02	7.00E-02	mg/kg	6	0
		Nitrosodiphenylamine, N-				7.00E-02	9.50E-02	9.14E-02	mg/kg	7	0
		Nitrotoluene, 2-				2.50E-01	2.50E-01	2.50E-01	mg/kg	3	0
		Nitrotoluene, 3-				2.50E-01	2.50E-01	2.50E-01	mg/kg	3	0
		Nitrotoluene, 4-				2.50E-01	2.50E-01	2.50E-01	mg/kg	3	0
		Organic carbon, total (TOC)	1.77E+04	1.77E+04	1.77E+04				mg/kg	1	1
		PCB 1016				6.50E-03	7.00E-01	5.06E-01	mg/kg	7	0
		PCB 1221				6.50E-03	7.00E-01	5.07E-01	mg/kg	7	0
		PCB 1232				6.50E-03	7.00E-01	5.07E-01	mg/kg	7	0
		PCB 1242				6.50E-03	7.00E-01	5.07E-01	mg/kg	7	0
		PCB 1248				6.50E-03	1.00E+00	7.21E-01	mg/kg	7	0
		PCB 1254				6.50E-03	1.15E+00	8.28E-01	mg/kg	7	0
		PCB 1260				6.50E-03	1.30E+00	9.35E-01	mg/kg	7	0
		PETN				2.00E+00	2.00E+00	2.00E+00	mg/kg	5	0
		Pentachlorophenol				3.35E-01	6.50E-01	6.05E-01	mg/kg	7	0
		Phenanthrene	5.20E-02	5.30E-02	5.25E-02	1.65E-02	7.00E-02	2.24E-02	mg/kg	11	2
		Phenol				5.50E-02	7.00E-02	5.71E-02	mg/kg	7	0
		Potassium	2.54E+02	2.01E+03	7.23E+02	7.65E+01	1.61E+02	1.21E+02	mg/kg	11	6
		Pyrene	8.44E-03	2.76E-02	1.46E-02	1.65E-02	7.00E-02	2.41E-02	mg/kg	11	4
		RDX				2.50E-01	2.94E-01	2.77E-01	mg/kg	8	0
		Selenium				1.25E-01	1.25E-01	1.25E-01	mg/kg	11	0
		Silver				2.50E-01	1.25E+00	7.95E-01	mg/kg	11	0
		Silvex (2,4,5-TP)				4.25E-03	4.25E-03	4.25E-03	mg/kg	1	0
		Sodium	1.25E+02	5.13E+02	3.80E+02				mg/kg	11	11
		Styrene				1.30E-03	1.30E-03	1.30E-03	mg/kg	6	0
		Tetrachloroethane, 1,1,2,2-				1.20E-03	1.20E-03	1.20E-03	mg/kg	6	0
		Tetrachloroethene				4.05E-04	4.05E-04	4.05E-04	mg/kg	6	0
		Tetryl				2.50E-01	3.66E-01	3.22E-01	mg/kg	8	0
		Thallium				1.25E-01	1.25E-01	1.25E-01	mg/kg	5	0
		Toluene				3.90E-04	3.90E-04	3.90E-04	mg/kg	6	0
		Toxaphene				1.50E-01	1.30E+00	9.82E-01	mg/kg	7	0
		Trichlorobenzene, 1,2,4-				2.00E-02	7.00E-02	2.71E-02	mg/kg	7	0
		Trichloroethane, 1,1,1-				2.20E-03	2.20E-03	2.20E-03	mg/kg	6	0
		Trichloroethane, 1,1,2-				2.70E-03	2.70E-03	2.70E-03	mg/kg	6	0
		Trichloroethene				1.40E-03	1.40E-03	1.40E-03	mg/kg	6	0
		Trichlorofluoromethane	6.80E-03	1.00E-02	8.00E-03	2.95E-03	2.95E-03	2.95E-03	mg/kg	6	3
		Trichlorophenol, 2,4,5-				5.00E-02	1.50E-01	6.43E-02	mg/kg	7	0
		Trichlorophenol, 2,4,6-				8.50E-02	1.50E-01	9.43E-02	mg/kg	7	0
		Trinitrobenzene, 1,3,5-				1.25E-01	2.44E-01	2.24E-01	mg/kg	6	0
		Trinitrotoluene, 2,4,6-				1.25E-01	2.28E-01	1.89E-01	mg/kg	8	0
		Triphenylene	2.92E-01	2.92E-01	2.92E-01				mg/kg	2	2
		Vanadium	5.98E+00	5.90E+01	2.10E+01	6.50E+00	6.50E+00	6.50E+00	mg/kg	11	8
		Vinyl acetate				1.60E-03	1.60E-03	1.60E-03	mg/kg	6	0
		Vinyl chloride				3.10E-03	3.10E-03	3.10E-03	mg/kg	6	0
		Xylenes, total				7.50E-04	7.50E-04	7.50E-04	mg/kg	6	0
		Zinc	2.18E+01	1.40E+02	4.98E+01	1.51E+01	1.51E+01	1.51E+01	mg/kg	11	8
Sediment	Hutchinson Ravine	2,4,5-T				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	1
		2,4-DB				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Acenaphthene	2.14E-01	2.45E+00	1.13E+00	1.80E-02	1.50E-01	8.29E-02	mg/kg	11	6

d:\mary\ftsher2\surplsou\drftfin\l\bcrravs\data\sum\hmdsum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Hutchinson Ravine	Acenaphthylene	1.37E-01	1.73E+00	9.18E-01	1.65E-02	3.50E-01	1.22E-01	mg/kg	11	3
		Acetone				5.00E-03	8.50E-03	5.58E-03	mg/kg	6	0
		Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/kg	1	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/kg	1	0
		Aldrin	4.33E-03	2.53E-02	1.55E-02	1.50E-03	1.65E-01	2.19E-02	mg/kg	11	3
		Aluminum	3.51E+03	9.10E+03	5.57E+03	1.02E+03	2.83E+03	1.95E+03	mg/kg	11	7
		Amino-2,6-dinitrotoluene, 4-				1.25E-01	1.25E-01	1.25E-01	mg/kg	7	0
		Amino-4,6-dinitrotoluene, 2-				1.25E-01	1.25E-01	1.25E-01	mg/kg	7	0
		Anthracene	3.30E-01	7.00E+00	2.96E+00	1.65E-02	1.50E-01	8.66E-02	mg/kg	11	7
		Antimony	7.65E+00	7.88E+00	7.77E+00	1.90E+00	2.50E+00	2.43E+00	mg/kg	11	2
		Arsenic	4.01E+00	7.35E+00	5.70E+00				mg/kg	11	11
		Barium	3.91E+01	6.45E+01	5.50E+01	1.48E+01	2.00E+01	1.93E+01	mg/kg	11	4
		Benz(a)anthracene	7.10E-02	1.00E+01	2.18E+00	8.50E-02	1.50E-01	1.15E-01	mg/kg	11	8
		Benzene				7.50E-04	5.00E-03	4.29E-03	mg/kg	6	0
		Benzidine				4.25E-01	4.25E-01	4.25E-01	mg/kg	1	0
		Benzo(a)pyrene	7.10E-02	8.00E+00	1.79E+00	1.10E-01	1.50E-01	1.28E-01	mg/kg	11	8
		Benzo(b)fluoranthene	8.90E-02	8.00E+00	1.80E+00	1.05E-01	1.50E-01	1.22E-01	mg/kg	11	8
		Benzo(ghi)perylene	1.20E-01	4.00E+00	1.42E+00	6.50E-02	1.50E-01	1.09E-01	mg/kg	11	5
		Benzo(k)fluoranthene	2.70E-02	5.00E+00	1.08E+00	1.10E-01	1.50E-01	1.30E-01	mg/kg	11	9
		Benzoic acid				7.00E-01	3.50E+00	1.51E+00	mg/kg	11	0
		Benzyl alcohol				7.00E-02	3.50E-01	1.32E-01	mg/kg	11	0
		Beryllium	2.97E-01	8.37E-01	4.82E-01	1.00E-01	9.30E-01	5.15E-01	mg/kg	11	9
		Bis(2-chloroethoxy) methane				2.95E-02	3.50E-01	1.26E-01	mg/kg	11	0
		Bis(2-chloroethyl) ether				1.65E-02	3.50E-01	1.25E-01	mg/kg	11	0
		Bis(2-chloroisopropyl) ether				7.00E-02	3.50E-01	1.33E-01	mg/kg	11	0
		Bis(2-ethylhexyl) phthalate	2.15E-01	2.15E-01	2.15E-01	7.00E-02	3.50E-01	1.60E-01	mg/kg	11	1
		Bromodichloromethane				1.45E-03	5.00E-03	4.41E-03	mg/kg	6	0
		Bromoform				3.45E-03	5.00E-03	4.74E-03	mg/kg	6	0
		Bromomethane				2.85E-03	5.00E-03	4.64E-03	mg/kg	6	0
		Bromophenyl phenyl ether, 4-				1.65E-02	3.50E-01	1.25E-01	mg/kg	11	0
		Butylbenzyl phthalate				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Cadmium	5.37E-01	5.37E-01	5.37E-01	2.50E-01	1.53E+00	3.78E-01	mg/kg	11	1
		Calcium	2.45E+04	1.20E+05	5.81E+04				mg/kg	11	11
		Carbazole	1.00E+00	2.00E+00	1.50E+00	7.00E-02	2.50E-01	1.08E-01	mg/kg	10	2
		Carbon disulfide				2.20E-03	5.00E-03	4.53E-03	mg/kg	6	0
		Carbon tetrachloride				3.50E-03	5.00E-03	4.75E-03	mg/kg	6	0
		Chlordane, alpha-	8.60E-02	8.60E-02	8.60E-02	1.50E-03	1.65E-01	1.79E-02	mg/kg	11	1
		Chlordane, gamma-	3.04E-03	9.44E-02	4.87E-02	1.50E-03	1.65E-01	1.99E-02	mg/kg	11	2
		Chlordane, total	1.83E-02	9.30E-01	2.35E-01	1.00E-02	1.50E-02	1.10E-02	mg/kg	10	5
		Chloro-3-methylphenol, 4-				4.75E-02	3.50E-01	1.28E-01	mg/kg	11	0
		Chloroaniline, 4-				1.50E-01	1.00E+00	3.30E-01	mg/kg	11	0
		Chlorobenzene				4.30E-04	5.00E-03	4.24E-03	mg/kg	6	0
		Chloroethane				5.00E-03	6.00E-03	5.17E-03	mg/kg	6	0
		Chloroethylvinyl ether, 2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	6	0
		Chloroform				4.40E-03	5.00E-03	4.90E-03	mg/kg	6	0
		Chloromethane				1.80E-02	3.50E-01	1.25E-01	mg/kg	11	0
		Chloronaphthalene, 2-				3.00E-02	3.50E-01	1.26E-01	mg/kg	11	0
		Chlorophenol, 2-				1.65E-02	3.50E-01	1.25E-01	mg/kg	11	0
		Chlorophenyl phenyl ether, 4-				3.37E+00	6.35E+00	4.78E+00	mg/kg	11	8
		Chromium, total	4.22E+00	1.50E+01	9.00E+00	3.37E+00	6.35E+00	4.78E+00	mg/kg	11	8
		Chrysene	2.50E-01	1.00E+01	2.50E+00	6.50E-02	1.50E-01	1.08E-01	mg/kg	11	8
		Cobalt	3.29E+00	1.23E+01	7.91E+00	7.50E+00	7.50E+00	7.50E+00	mg/kg	11	10
		Copper	7.35E+00	2.65E+01	1.83E+01	2.93E+01	2.93E+01	2.93E+01	mg/kg	11	10
		Cyanide, total	7.83E-01	7.83E-01	7.83E-01	1.25E-01	4.60E-01	1.59E-01	mg/kg	11	1
		DDD, p,p'-				1.55E-01	1.55E-01	1.55E-01	mg/kg	11	11
		DDE, p,p'-	7.31E-03	5.90E-01	1.81E-01	1.55E-01	1.55E-01	1.55E-01	mg/kg	11	10
		DDT, p,p'-	5.28E-03	9.30E-01	3.33E-01	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dalapon				3.05E-02	3.50E-01	1.26E-01	mg/kg	11	0
		Di-n-butyl phthalate				7.00E-02	3.50E-01	1.32E-01	mg/kg	11	0
		Di-n-octyl phthalate							mg/kg	11	0

d:\mary\ftsher2\surpl\ou\drft\fin\bchra\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Hutchinson Ravine	Dibenz(ah)anthracene	2.70E-01	6.00E-01	4.35E-01	1.65E-02	4.00E-01	1.11E-01	mg/kg	11	2
		Dibenzofuran	6.00E-01	2.00E+00	1.30E+00	1.75E-02	2.50E-01	9.75E-02	mg/kg	11	2
		Dibromochloromethane				1.55E-03	5.00E-03	4.43E-03	mg/kg	6	0
		Dicamba				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichlorobenzene, 1,2-				5.00E-02	3.50E-01	1.29E-01	mg/kg	11	0
		Dichlorobenzene, 1,3-				6.50E-02	3.50E-01	1.30E-01	mg/kg	11	0
		Dichlorobenzene, 1,4-				4.90E-02	3.50E-01	1.28E-01	mg/kg	11	0
		Dichlorobenzenes, total				5.00E-02	5.00E-02	5.00E-02	mg/kg	1	0
		Dichlorobenzidine, 3,3'-				3.35E-01	3.15E+00	7.95E-01	mg/kg	11	0
		Dichloroethane, 1,1-				1.15E-03	5.00E-03	4.36E-03	mg/kg	6	0
		Dichloroethane, 1,2-				8.50E-04	5.00E-03	4.31E-03	mg/kg	6	0
		Dichloroethane, 1,1-				1.95E-03	5.00E-03	4.49E-03	mg/kg	6	0
		Dichloroethenes, 1,2-, total				1.50E-03	5.00E-03	4.42E-03	mg/kg	6	0
		Dichlorophenol, 2,4-				7.00E-02	3.50E-01	1.32E-01	mg/kg	11	0
		Dichloropropane, 1,2-				1.45E-03	5.00E-03	4.41E-03	mg/kg	6	0
		Dichloropropene, 1,3-, cis-				1.60E-03	5.00E-03	4.43E-03	mg/kg	6	0
		Dichloropropene, 1,3-, trans-				1.40E-03	5.00E-03	4.40E-03	mg/kg	6	0
		Dieldrin				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Diethyl phthalate				1.50E-03	1.55E-01	1.55E-02	mg/kg	11	0
		Dimethyl phthalate				7.00E-02	3.50E-01	1.35E-01	mg/kg	11	0
		Dimethylphenol, 2,4-				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Dinitro-2-methylphenol, 4,6-				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Dinitrobenzene, 1,3-				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Dinitrophenol, 2,4-				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Dinitrotoluene, 2,4-				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Dinitrotoluene, 2,6-				2.75E-01	3.50E+00	1.26E+00	mg/kg	11	0
		Dinoseb				1.25E-01	1.25E-01	1.25E-01	mg/kg	7	0
		Diphenylhydrazine, 1,2-				6.00E-01	3.50E+00	1.29E+00	mg/kg	11	0
		Endosulfan A				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Endosulfan B				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Endosulfan sulfate				4.25E-02	1.00E-01	8.11E-02	mg/kg	11	0
		Endrin	1.18E-02	2.03E-02	1.61E-02	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Endrin aldehyde				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Endrin ketone				1.50E-03	3.10E-01	2.95E-02	mg/kg	11	0
		Ethylbenzene				1.50E-03	3.10E-01	2.95E-02	mg/kg	11	0
		Fluoranthene				1.50E-03	3.10E-01	2.95E-02	mg/kg	11	0
		HMX				1.10E-02	2.65E-01	3.41E-02	mg/kg	11	0
		Heptachlor				1.50E-03	2.65E-01	2.55E-02	mg/kg	11	0
		Heptachlor epoxide				8.50E-04	5.00E-03	4.31E-03	mg/kg	6	0
		Hexachlorobenzene	2.20E-01	3.00E+01	5.19E+00	1.10E-01	1.50E-01	1.30E-01	mg/kg	11	9
		Hexachlorobutadiene	1.22E-01	4.00E+00	9.31E-01	1.65E-02	1.50E-01	7.26E-02	mg/kg	11	6
		Hexachlorocyclohexane, alpha-				2.50E-01	2.50E-01	2.50E-01	mg/kg	7	0
		Hexachlorocyclohexane, beta-				1.50E-03	6.50E-02	7.27E-03	mg/kg	11	0
		Hexachlorocyclohexane, delta-				1.50E-03	6.50E-02	7.27E-03	mg/kg	11	0
		Hexachlorocyclohexane, gamma-				1.50E-03	6.50E-02	7.27E-03	mg/kg	11	0
		Hexachlorocyclopentadiene	5.14E-03	6.28E-03	5.71E-03	1.50E-03	1.35E-01	1.63E-02	mg/kg	11	2
		Hexachloroethane				5.00E-01	3.10E+00	1.15E+00	mg/kg	11	0
		Indeno(1,2,3-cd)pyrene	9.40E-02	4.00E+00	1.14E+00	7.00E-02	3.50E-01	1.30E-01	mg/kg	11	0
		Iron	7.57E+03	2.22E+04	1.65E+04	1.65E-02	1.50E-01	1.01E-01	mg/kg	11	6
		Isophorone				1.65E-02	3.50E-01	1.25E-01	mg/kg	11	11
		Lead	1.20E+01	5.48E+01	3.14E+01	1.00E-01	1.00E-01	1.00E-01	mg/kg	11	11
		MCPA				1.00E-01	1.00E-01	1.00E-01	mg/kg	5	0
		MCPP				1.00E-01	1.00E-01	1.00E-01	mg/kg	5	0
		Magnesium	1.49E+04	5.80E+04	3.06E+04				mg/kg	11	11
		Manganese	2.96E+02	1.63E+03	8.47E+02	1.50E-03	1.65E-01	4.72E-02	mg/kg	11	2
		Mercury	1.02E-01	2.20E-01	1.61E-01	5.00E-02	5.00E-02	1.64E-02	mg/kg	11	0
		Methoxychlor				5.00E-03	3.50E-02	1.00E-02	mg/kg	6	0
		Methyl ethyl ketone				5.00E-03	1.35E-02	6.42E-03	mg/kg	6	0
		Methyl isobutyl ketone				5.00E-03	1.35E-02	6.42E-03	mg/kg	6	0
		Methyl n-butyl ketone				5.00E-03	1.60E-02	6.83E-03	mg/kg	6	0
		Methylene chloride				5.00E-03	6.00E-03	5.17E-03	mg/kg	6	0

d:\mary\ftsher2\surplson\drftfinl\bchra\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 11

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Hutchinson Ravine	Methylnaphthalene, 1-	3.98E-01	2.89E+00	1.61E+00	6.65E-02	6.65E-02	6.65E-02	mg/kg	5	4
		Methylnaphthalene, 2-	1.30E-01	3.70E+00	2.10E+00	6.65E-02	3.50E-01	1.49E-01	mg/kg	11	5
		Methylphenol, 2-				1.45E-02	3.50E-01	1.25E-01	mg/kg	11	0
		Methylphenol, 4-				7.00E-02	3.50E-01	1.35E-01	mg/kg	11	0
		Naphthalene	1.03E+00	2.31E+00	1.83E+00	1.85E-02	3.50E-01	1.23E-01	mg/kg	11	3
		Nickel	7.48E+00	4.13E+01	1.87E+01				mg/kg	11	11
		Nitroaniline, 2-				3.10E-02	1.50E+00	5.11E-01	mg/kg	11	0
		Nitroaniline, 3-				2.25E-01	1.50E+00	5.29E-01	mg/kg	11	0
		Nitroaniline, 4-				2.05E-01	1.50E+00	5.27E-01	mg/kg	11	0
		Nitrobenzene				2.25E-02	1.25E-01	8.93E-02	mg/kg	11	0
		Nitrophenol, 2-				7.00E-02	3.50E-01	1.30E-01	mg/kg	11	0
		Nitrophenol, 4-				7.00E-01	3.50E+00	1.30E+00	mg/kg	11	0
		Nitrosodi-N-propylamine, N-				7.00E-02	3.50E-01	1.33E-01	mg/kg	11	0
		Nitrosodimethylamine, N-				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nitrosodiphenylamine, N-				7.00E-02	3.50E-01	1.32E-01	mg/kg	11	0
		Nitrotoluene, 2-				2.50E-01	2.50E-01	2.50E-01	mg/kg	7	0
		Nitrotoluene, 3-				2.50E-01	2.50E-01	2.50E-01	mg/kg	7	0
		Nitrotoluene, 4-				2.50E-01	2.50E-01	2.50E-01	mg/kg	7	0
		Organic carbon, total (TOC)	1.98E+04	9.12E+04	4.81E+04				mg/kg	5	5
		PCB 1016				6.50E-03	7.00E-01	6.95E-02	mg/kg	11	0
		PCB 1221				6.50E-03	7.00E-01	6.95E-02	mg/kg	11	0
		PCB 1232				6.50E-03	7.00E-01	6.95E-02	mg/kg	11	0
		PCB 1242				6.50E-03	7.00E-01	6.95E-02	mg/kg	11	0
		PCB 1248				6.50E-03	1.00E+00	9.68E-02	mg/kg	11	0
		PCB 1254				6.50E-03	1.15E+00	1.10E-01	mg/kg	11	0
		PCB 1260				6.50E-03	1.30E+00	1.24E-01	mg/kg	11	0
		Pentachlorophenol				3.35E-01	1.50E+00	5.68E-01	mg/kg	11	0
		Petroleum hydrocarbons, total (TPH)	3.44E+01	8.92E+01	6.02E+01				mg/kg	5	5
		Phenanthrene	1.50E-01	3.00E+01	4.66E+00	1.10E-01	1.10E-01	1.10E-01	mg/kg	11	10
		Phenol				5.50E-02	3.50E-01	1.29E-01	mg/kg	11	0
		Potassium	6.81E+02	2.41E+03	1.48E+03	2.01E+02	4.50E+02	3.47E+02	mg/kg	11	4
		Pyrene	1.10E-01	2.00E+01	4.16E+00	1.10E-01	1.50E-01	1.30E-01	mg/kg	11	9
		RDX				2.50E-01	2.50E-01	2.50E-01	mg/kg	7	0
		Selenium	2.71E-01	2.71E-01	2.71E-01	1.25E-01	1.25E-01	1.25E-01	mg/kg	11	1
		Silver	1.05E+00	1.05E+00	1.05E+00	2.50E-01	1.25E+00	3.50E-01	mg/kg	11	1
		Silvex (2,4,5-TP)				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Sodium	3.43E+02	1.18E+03	6.59E+02				mg/kg	11	11
		Styrene				1.30E-03	5.00E-03	4.38E-03	mg/kg	6	0
		Tetrachloroethane, 1,1,2,2-				1.20E-03	5.00E-03	4.37E-03	mg/kg	6	0
		Tetrachloroethene				4.05E-04	5.00E-03	4.23E-03	mg/kg	6	0
		Tetryl				2.50E-01	2.50E-01	2.50E-01	mg/kg	7	0
		Thallium	3.15E-01	4.45E-01	3.73E-01	1.25E-01	1.25E-01	1.25E-01	mg/kg	10	3
		Toluene				3.90E-04	5.00E-03	4.23E-03	mg/kg	6	0
		Toxaphene				1.50E-01	1.30E+00	2.55E-01	mg/kg	11	0
		Trichlorobenzene, 1,2,4-				2.00E-02	3.50E-01	1.25E-01	mg/kg	11	0
		Trichloroethane, 1,1,1-				2.20E-03	5.00E-03	4.53E-03	mg/kg	6	0
		Trichloroethane, 1,1,2-				2.70E-03	5.00E-03	4.62E-03	mg/kg	6	0
		Trichloroethene				1.40E-03	5.00E-03	4.40E-03	mg/kg	6	0
		Trichlorofluoromethane	1.20E-02	1.20E-02	1.20E-02				mg/kg	1	1
		Trichlorophenol, 2,4,5-				5.00E-02	1.00E+00	2.98E-01	mg/kg	11	0
		Trichlorophenol, 2,4,6-				8.50E-02	1.00E+00	3.01E-01	mg/kg	11	0
		Trinitrobenzene, 1,3,5-				1.25E-01	1.25E-01	1.25E-01	mg/kg	7	0
		Trinitrobenzene, 1,3,5-				1.25E-01	1.25E-01	1.25E-01	mg/kg	7	0
		Trinitrotoluene, 2,4,6-				6.80E+00	9.00E+00	7.82E+00	mg/kg	11	8
		Vanadium	7.74E+00	3.10E+01	1.52E+01	6.80E+00	9.00E+00	7.82E+00	mg/kg	11	8
		Vinyl acetate				1.60E-03	5.00E-03	4.43E-03	mg/kg	6	0
		Vinyl chloride				3.10E-03	5.00E-03	4.68E-03	mg/kg	6	0
		Xylenes, total	2.23E+01	1.02E+02	7.12E+01	7.50E-04	5.00E-03	4.29E-03	mg/kg	11	11
		Zinc							mg/kg	4	0
		2,4,5-T				5.00E-03	5.00E-03	5.00E-03	mg/kg	4	0

d:\mary\ftsher2\surplou\drftfinl\bchra\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Janes Ravine	2,4-D				5.00E-03	8.85E-03	6.65E-03	mg/kg	7	0
		2,4-DB				5.00E-03	5.00E-03	5.00E-03	mg/kg	4	0
		Acenaphthene	1.60E-01	1.78E+00	1.11E+00	1.80E-02	1.00E+00	1.61E-01	mg/kg	12	3
		Acenaphthylene				1.65E-02	1.00E+00	1.37E-01	mg/kg	12	0
		Acetone				5.00E-03	8.50E-03	6.50E-03	mg/kg	7	0
		Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/kg	2	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/kg	2	0
		Aldrin	2.07E+03	1.38E+04	7.17E+03	1.50E-03	3.65E-03	2.14E-03	mg/kg	10	0
		Aluminum				7.45E+02	1.49E+03	1.12E+03	mg/kg	12	10
		Amino-2,6-dinitrotoluene, 4-				1.25E-01	1.25E-01	1.25E-01	mg/kg	4	0
		Amino-4,6-dinitrotoluene, 2-				1.25E-01	1.25E-01	1.25E-01	mg/kg	4	0
		Anthracene				1.25E-01	1.25E-01	1.25E-01	mg/kg	4	0
		Antimony	5.37E-02	1.29E+00	5.02E-01	1.25E-01	1.25E-01	1.25E-01	mg/kg	12	4
		Arsenic	9.23E+00	9.23E+00	9.23E+00	1.00E+00	1.00E+00	1.73E-01	mg/kg	12	4
		Barium	2.28E+00	1.57E+01	6.37E+00	1.90E+00	2.50E+00	2.34E+00	mg/kg	12	1
		Benz(a)anthracene	5.58E+01	1.13E+02	7.60E+01	1.48E+01	2.00E+01	1.85E+01	mg/kg	12	5
		Benzene	4.20E-02	2.30E-01	1.51E-01	1.60E-02	4.00E+00	5.04E-01	mg/kg	12	3
		Benzidine				7.50E-04	5.00E-03	3.18E-03	mg/kg	7	0
		Benzo(a)pyrene	3.20E-02	3.60E-01	1.74E-01	4.25E-01	4.25E-01	4.25E-01	mg/kg	2	0
		Benzo(b)fluoranthene	4.60E-02	4.30E-01	2.09E-01	7.00E-02	5.00E+00	7.00E-01	mg/kg	12	4
		Benzo(ghi)perylene	2.03E-02	4.10E-01	1.72E-01	7.00E-02	5.00E+00	6.95E-01	mg/kg	12	4
		Benzo(k)fluoranthene	2.80E-02	2.80E-01	1.55E-01	3.35E-02	5.00E+00	6.32E-01	mg/kg	12	3
		Benzoic acid	6.30E-01	6.30E-01	6.30E-01	9.00E-03	1.50E+00	2.37E-01	mg/kg	12	4
		Benzyl alcohol				7.00E-02	5.00E+01	2.60E+00	mg/kg	11	1
		Beryllium	2.96E-01	7.28E-01	5.22E-01	7.00E-02	5.00E+01	4.35E+00	mg/kg	12	0
		Bis(2-chloroethoxy) methane				1.00E-01	9.30E-01	5.98E-01	mg/kg	12	7
		Bis(2-chloroethyl) ether				2.95E-02	1.50E+00	3.02E-01	mg/kg	12	0
		Bis(2-chloroisopropyl) ether				1.65E-02	1.50E+00	2.58E-01	mg/kg	12	0
		Bis(2-ethylhexyl) phthalate				7.00E-02	5.00E+00	6.05E-01	mg/kg	12	0
		Bromodichloromethane				1.45E-03	5.00E-03	3.48E-03	mg/kg	7	0
		Bromoform				3.45E-03	5.00E-03	4.34E-03	mg/kg	7	0
		Bromomethane				2.85E-03	5.00E-03	4.08E-03	mg/kg	7	0
		Bromophenyl phenyl ether, 4-				1.65E-02	1.50E+00	2.58E-01	mg/kg	12	0
		Butylbenzyl phthalate				7.00E-02	4.00E+00	5.19E-01	mg/kg	12	0
		Cadmium	9.00E-01	9.00E-01	9.00E-01	2.50E-01	1.53E+00	5.98E-01	mg/kg	12	1
		Calcium	3.83E+03	1.50E+05	5.33E+04				mg/kg	12	12
		Carbazole				7.00E-02	1.50E+00	2.29E-01	mg/kg	9	0
		Carbon disulfide				2.20E-03	5.00E-03	3.80E-03	mg/kg	7	0
		Carbon tetrachloride				3.50E-03	5.00E-03	4.36E-03	mg/kg	7	0
		Chlordane, alpha-	3.25E-02	3.25E-02	3.25E-02	1.50E-03	1.65E-01	4.30E-02	mg/kg	9	1
		Chlordane, gamma-	2.85E-02	2.85E-02	2.85E-02	1.50E-03	1.65E-01	4.31E-02	mg/kg	9	1
		Chlordane, total	3.06E-02	5.20E+00	1.15E+00	8.85E-03	1.00E-02	9.54E-03	mg/kg	10	5
		Chloro-3-methylphenol, 4-				4.75E-02	2.50E+00	3.88E-01	mg/kg	12	0
		Chloroaniline, 4-				1.50E-01	2.00E+01	2.08E+00	mg/kg	12	0
		Chlorobenzene				4.30E-04	5.00E-03	3.04E-03	mg/kg	7	0
		Chloroethane				5.00E-03	5.00E-03	5.43E-03	mg/kg	7	0
		Chloroethylvinyl ether, 2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	6	0
		Chloromethane				4.35E-04	5.00E-03	3.04E-03	mg/kg	7	0
		Chloroform				4.40E-03	5.00E-03	4.74E-03	mg/kg	7	0
		Chloronaphthalene, 2-				1.80E-02	1.50E+00	2.58E-01	mg/kg	12	0
		Chlorophenol, 2-				3.00E-02	1.50E+00	3.02E-01	mg/kg	12	0
		Chlorophenyl phenyl ether, 4-				1.65E-02	1.50E+00	2.58E-01	mg/kg	12	0
		Chromium, total	3.82E+00	2.24E+01	1.27E+01	3.06E+00	6.35E+00	5.53E+00	mg/kg	12	8
		Chrysene	2.49E-02	3.30E-01	1.41E-01	6.00E-02	3.00E+00	4.87E-01	mg/kg	12	5
		Cobalt	4.15E+00	1.34E+01	9.44E+00	1.00E+00	7.50E+00	5.88E+00	mg/kg	12	8
		Copper	1.12E+01	2.68E+01	1.83E+01	2.93E+01	2.93E+01	2.93E+01	mg/kg	12	9
		Cyanide, total				1.25E-01	4.60E-01	2.51E-01	mg/kg	8	0
		DDD, P,p'-	7.30E-02	6.60E+00	1.60E+00	1.50E-03	4.13E-03	2.38E-03	mg/kg	10	7
		DDE, P,p'-	5.33E-03	4.90E-01	1.05E-01	3.83E-03	3.83E-03	3.83E-03	mg/kg	10	9
		DDT, P,p'-	4.48E-03	5.80E+00	1.15E+00	3.54E-03	3.54E-03	3.54E-03	mg/kg	10	9

d:\mary\ftsher2\surplsol\drftfinl\bchravs\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Janes Ravine	Dalapon	1.80E+00	1.00E+01	5.90E+00	5.00E-03	5.00E-03	5.00E-03	mg/kg	4	0
		Di-n-butyl phthalate				3.05E-02	1.50E+00	3.79E-01	mg/kg	12	3
		Di-n-octyl phthalate				7.00E-02	5.00E+01	4.35E+00	mg/kg	12	0
		Dibenz(a,h)anthracene	6.24E-03	9.40E-02	5.01E-02	1.65E-02	5.00E+00	5.67E-01	mg/kg	12	2
		Dibenzofuran				1.75E-02	1.50E+00	2.58E-01	mg/kg	12	0
		Dibromochloromethane				1.55E-03	5.00E-03	5.52E-03	mg/kg	7	0
		Dicamba				5.00E-03	5.00E-03	5.00E-03	mg/kg	4	0
		Dichlorobenzene, 1,2-				5.50E-02	3.00E+00	4.31E-01	mg/kg	12	0
		Dichlorobenzene, 1,3-				4.90E-02	2.50E+00	3.88E-01	mg/kg	12	0
		Dichlorobenzenes, total				5.00E-02	5.00E-02	5.00E-02	mg/kg	2	0
		Dichlorobenzidine, 3,3'-				3.35E-01	1.50E+02	1.37E+01	mg/kg	12	0
		Dichloroethane, 1,1-				1.15E-03	5.00E-03	3.35E-03	mg/kg	7	0
		Dichloroethane, 1,2-				8.50E-04	5.00E-03	3.22E-03	mg/kg	7	0
		Dichloroethene, 1,1-				1.95E-03	5.00E-03	3.69E-03	mg/kg	7	0
		Dichloroethenes, 1,2-, total				1.50E-03	5.00E-03	5.00E-03	mg/kg	7	0
		Dichlorophenol, 2,4-				7.00E-02	4.50E+00	5.62E-01	mg/kg	12	0
		Dichloropropene, 1,2-				1.45E-03	5.00E-03	3.48E-03	mg/kg	7	0
		Dichloropropene, 1,3-, cis-				1.60E-03	5.00E-03	3.54E-03	mg/kg	7	0
		Dichloropropene, 1,3-, trans-				1.40E-03	5.00E-03	3.46E-03	mg/kg	7	0
		Dichloroprop				5.00E-03	5.00E-03	5.00E-03	mg/kg	4	0
		Dieldrin				1.50E-03	3.15E-03	1.99E-03	mg/kg	10	0
		Diethyl phthalate				7.00E-02	5.00E+00	6.08E-01	mg/kg	12	0
		Dimethyl phthalate				7.00E-02	4.00E+00	5.19E-01	mg/kg	12	0
		Dimethylphenol, 2,4-				7.00E-02	1.50E+01	1.40E+00	mg/kg	12	0
		Dinitro-2-methylphenol, 4,6-				2.75E-01	1.50E+01	3.01E+00	mg/kg	12	0
		Dinitrobenzene, 1,3-				1.25E-01	1.25E-01	1.25E-01	mg/kg	4	0
		Dinitrophenol, 2,4-				6.00E-01	3.00E+01	4.32E+00	mg/kg	12	0
		Dinitrotoluene, 2,4-				7.00E-02	3.50E+00	4.75E-01	mg/kg	12	0
		Dinitrotoluene, 2,6-				4.25E-02	2.00E+00	3.45E-01	mg/kg	12	0
		Dinoseb				5.00E-03	5.00E-03	5.00E-03	mg/kg	4	0
		Diphenylhydrazine, 1,2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	2	0
		Endosulfan A				1.50E-03	3.01E-03	1.95E-03	mg/kg	10	0
		Endosulfan B				1.50E-03	3.32E-03	2.04E-03	mg/kg	10	0
		Endosulfan sulfate				1.50E-03	3.82E-03	2.19E-03	mg/kg	10	0
		Endrin				1.50E-03	3.30E-02	5.01E-03	mg/kg	10	0
		Endrin aldehyde				1.10E-02	1.20E-02	1.13E-02	mg/kg	10	0
		Endrin ketone				1.50E-03	2.65E-01	6.01E-02	mg/kg	9	0
		Ethylbenzene	1.00E-01	6.50E-01	3.25E-01	8.50E-04	5.00E-03	3.22E-03	mg/kg	7	0
		Fluoranthene	2.04E-01	2.99E-01	2.52E-01	1.65E-02	1.50E+00	3.02E-01	mg/kg	12	6
		Fluorene				2.50E-01	2.50E-01	2.50E-01	mg/kg	4	0
		HMX				1.50E-03	3.10E-02	4.77E-03	mg/kg	10	0
		Heptachlor				1.50E-03	3.10E-03	1.98E-03	mg/kg	10	0
		Heptachlor epoxide				1.50E-03	1.50E+00	2.58E-01	mg/kg	12	0
		Hexachlorobenzene				7.00E-02	5.00E+00	6.08E-01	mg/kg	12	0
		Hexachlorobutadiene				1.50E-03	4.54E-03	2.41E-03	mg/kg	10	0
		Hexachlorocyclohexane, alpha-				1.29E-03	1.50E-03	1.44E-03	mg/kg	10	0
		Hexachlorocyclohexane, beta-				1.50E-03	2.78E-03	1.88E-03	mg/kg	10	0
		Hexachlorocyclohexane, delta-				1.50E-03	3.19E-03	1.92E-03	mg/kg	10	2
		Hexachlorocyclopentadiene	7.29E-03	7.10E-02	3.91E-02	5.00E-01	1.50E+02	1.42E+01	mg/kg	12	0
		Hexachloroethane				7.00E-02	4.00E+00	5.18E-01	mg/kg	12	0
		Indeno(1,2,3-cd)pyrene	1.50E-01	2.40E-01	1.95E-01	1.65E-02	5.00E+00	5.75E-01	mg/kg	12	2
		Iron	4.98E+03	3.10E+04	1.58E+04				mg/kg	12	12
		Isodrin				2.31E-03	2.31E-03	2.31E-03	mg/kg	3	0
		Isophorone				1.65E-02	1.50E+00	2.58E-01	mg/kg	12	0
		Lead	7.02E+00	1.04E+02	2.93E+01				mg/kg	12	12
		MCPA				1.00E-01	1.00E-01	1.00E-01	mg/kg	4	0
		MCPP				1.00E-01	1.00E-01	1.00E-01	mg/kg	4	0
		Magnesium	4.64E+03	7.60E+04	2.90E+04				mg/kg	12	12
		Manganese	2.64E+02	2.04E+03	7.30E+02				mg/kg	12	12
		Mercury	1.95E+00	2.30E+00	2.13E+00	2.50E-02	5.00E-02	4.50E-02	mg/kg	12	2
		Methoxychlor	1.06E-01	1.06E-01	1.06E-01	1.50E-03	3.56E-02	9.07E-03	mg/kg	10	1

d:\mary\fisher2\surplusou\driftnl\bchravs\datasum\humdasum.lst



Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	James Ravine	Methyl ethyl ketone	-	-	-	5.00E-03	3.50E-02	1.79E-02	mg/kg	7	0
		Methyl isobutyl ketone	-	-	-	5.00E-03	1.35E-02	8.64E-03	mg/kg	7	0
		Methyl n-butyl ketone	-	-	-	5.00E-03	1.60E-02	9.71E-03	mg/kg	7	0
		Methylene chloride	-	-	-	5.00E-03	6.00E-03	5.43E-03	mg/kg	7	0
		Methylnaphthalene, 1-	2.58E-01	2.58E-01	2.58E-01	6.65E-02	6.65E-02	6.65E-02	mg/kg	4	1
		Methylnaphthalene, 2-	3.70E-01	8.00E+00	2.64E+00	7.00E-02	7.00E-02	6.39E-02	mg/kg	12	4
		Methylphenol, 2-	-	-	-	1.45E-02	1.50E+00	2.16E-01	mg/kg	12	0
		Methylphenol, 4-	-	-	-	7.00E-02	5.00E+00	6.08E-01	mg/kg	12	0
		Naphthalene	1.50E-01	6.87E-01	3.53E-01	1.85E-02	1.00E+00	1.79E-01	mg/kg	12	4
		Nickel	7.07E+00	3.84E+01	2.18E+01	6.30E+00	6.30E+00	6.30E+00	mg/kg	12	11
		Nitroaniline, 2-	-	-	-	3.10E-02	5.00E+00	7.0E-01	mg/kg	12	0
		Nitroaniline, 3-	-	-	-	2.25E-01	1.00E+01	1.51E+00	mg/kg	12	0
		Nitroaniline, 4-	-	-	-	2.05E-01	1.00E+01	1.51E+00	mg/kg	12	0
		Nitrobenzene	-	-	-	2.25E-02	1.50E+00	2.59E-01	mg/kg	12	0
		Nitrophenol, 2-	-	-	-	7.00E-02	3.50E+01	4.75E-01	mg/kg	12	0
		Nitrophenol, 4-	-	-	-	7.00E-02	5.00E+00	6.05E-01	mg/kg	12	0
		Nitrosodi-N-propylamine, N-	-	-	-	7.00E-02	7.00E-02	7.00E-02	mg/kg	2	0
		Nitrosodimethylamine, N-	-	-	-	7.00E-02	7.00E-02	7.00E-02	mg/kg	2	0
		Nitrosodiphenylamine, N-	-	-	-	7.00E-02	5.00E+01	4.35E+00	mg/kg	12	0
		Nitrotoluene, 2-	-	-	-	2.50E-01	2.50E-01	2.50E-01	mg/kg	4	0
		Nitrotoluene, 3-	-	-	-	2.50E-01	2.50E-01	2.50E-01	mg/kg	4	0
		Nitrotoluene, 4-	-	-	-	2.50E-01	2.50E-01	2.50E-01	mg/kg	4	0
		Organic carbon, total (TOC)	2.89E+04	3.69E+04	3.29E+04	6.50E-03	3.35E-01	4.47E-02	mg/kg	3	3
		PCB 1016	-	-	-	6.50E-03	4.10E-01	5.52E-02	mg/kg	10	0
		PCB 1221	-	-	-	6.50E-03	4.10E-01	5.52E-02	mg/kg	9	0
		PCB 1232	-	-	-	6.50E-03	4.10E-01	5.52E-02	mg/kg	9	0
		PCB 1242	-	-	-	6.50E-03	4.10E-01	5.52E-02	mg/kg	9	0
		PCB 1248	-	-	-	6.50E-03	4.10E-01	5.52E-02	mg/kg	9	0
		PCB 1254	-	-	-	6.50E-03	4.10E-01	5.52E-02	mg/kg	9	0
		PCB 1260	-	-	-	6.50E-03	4.10E-01	5.52E-02	mg/kg	10	0
		Pentachlorophenol	6.74E+01	4.32E+02	2.09E+02	3.35E-01	3.00E+01	3.25E+00	mg/kg	12	6
		Petroleum hydrocarbons, total (TPH)	4.60E-02	3.66E-01	2.23E-01	7.00E-02	1.00E+00	2.25E-01	mg/kg	12	6
		Phenanthrene	-	-	-	5.50E-02	3.00E+00	4.31E-01	mg/kg	12	0
		Phenol	4.43E+02	3.07E+03	1.65E+03	1.50E+02	3.91E+02	2.52E+02	mg/kg	12	8
		Potassium	1.84E-01	1.30E+00	6.95E-01	1.65E-02	1.00E+00	1.95E-01	mg/kg	12	5
		Pyrene	-	-	-	2.50E-01	2.50E-01	2.50E-01	mg/kg	4	0
		RDX	-	-	-	1.25E-01	1.25E-01	1.25E-01	mg/kg	12	0
		Selenium	6.30E-01	6.30E-01	6.30E-01	2.50E-01	1.25E+00	5.23E-01	mg/kg	12	1
		Silver	-	-	-	4.25E-03	5.00E-03	4.68E-03	mg/kg	7	0
		Silvex (2,4,5-TP)	-	-	-	-	-	-	mg/kg	12	12
		Sodium	4.19E+02	6.97E+02	5.73E+02	1.30E-03	5.00E-03	3.41E-03	mg/kg	7	0
		Styrene	-	-	-	1.20E-03	5.00E-03	3.37E-03	mg/kg	7	0
		Tetrachloroethane, 1,1,2,2-	-	-	-	4.05E-04	5.00E-03	3.03E-03	mg/kg	7	0
		Tetrachloroethene	-	-	-	2.50E-01	2.50E-01	2.50E-01	mg/kg	4	0
		Tetryl	3.26E-01	4.99E-01	4.01E-01	1.25E-01	1.25E-01	1.25E-01	mg/kg	9	4
		Thallium	1.40E-03	1.40E-03	1.40E-03	3.90E-04	5.00E-03	3.46E-03	mg/kg	7	1
		Toluene	-	-	-	1.50E-01	2.22E-01	1.72E-01	mg/kg	10	0
		Toxaphene	-	-	-	2.00E-02	1.50E+00	2.58E-01	mg/kg	12	0
		Trichlorobenzene, 1,2,4-	-	-	-	2.20E-03	5.00E-03	3.80E-03	mg/kg	7	0
		Trichloroethane, 1,1,1-	-	-	-	2.70E-03	5.00E-03	4.01E-03	mg/kg	7	0
		Trichloroethane, 1,1,2-	-	-	-	1.40E-03	5.00E-03	3.46E-03	mg/kg	7	0
		Trichloroethene	-	-	-	2.95E-03	2.95E-03	2.95E-03	mg/kg	3	0
		Trichlorofluoromethane	-	-	-	5.00E-02	3.00E+00	5.67E-01	mg/kg	12	0
		Trichlorophenol, 2,4,5-	-	-	-	8.50E-02	4.00E+00	6.98E-01	mg/kg	12	0
		Trichlorophenol, 2,4,6-	-	-	-	1.25E-01	1.25E-01	1.25E-01	mg/kg	3	0
		Trinitrobenzene, 1,3,5-	-	-	-	1.25E-01	1.25E-01	1.25E-01	mg/kg	4	0
		Trinitrotoluene, 2,4,6-	-	-	-	1.25E-01	1.25E-01	1.25E-01	mg/kg	2	2
		Triphenylene	2.13E-01	3.15E-01	2.64E-01	6.50E+00	7.25E+00	6.88E+00	mg/kg	12	10
		Vanadium	6.76E+00	4.12E+01	2.13E+01	1.60E-03	5.00E-03	3.54E-03	mg/kg	7	0
		Vinyl acetate	-	-	-	3.10E-03	5.00E-03	4.19E-03	mg/kg	7	0
		Vinyl chloride	1.80E-02	1.80E-02	1.80E-02	7.50E-04	5.00E-03	3.58E-03	mg/kg	7	1
		Xylenes, total	2.60E+01	3.75E+02	1.35E+02	1.51E+01	1.51E+01	1.51E+01	mg/kg	12	11
		Zinc	-	-	-	-	-	-	mg/kg	12	11

d:\mary\ftsht2\surplson\drftfin\bcbravs\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Background Ravine	2,4,5-T	.	.	.	5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		2,4-D	.	.	.	5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		2,4-DB	.	.	.	5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Acenaphthene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Acenaphthylene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Acetone	.	.	.	5.00E-03	9.00E-03	6.45E-03	mg/L	5	0
		Aldrin	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Aluminum	1.62E-01	1.03E+00	5.25E-01	2.00E-02	2.00E-02	2.00E-02	mg/L	5	3
		Amino-2,6-dinitrotoluene, 4-	.	.	.	5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Amino-4,6-dinitrotoluene, 2-	1.26E-04	1.26E-04	1.26E-04	5.00E-05	5.00E-05	5.00E-05	mg/L	5	1
		Anthracene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Antimony	2.60E-03	2.70E-03	2.65E-03	2.50E-02	2.50E-02	2.50E-02	mg/L	5	0
		Arsenic	5.00E-02	6.62E-02	5.73E-02	1.25E-03	1.25E-03	1.25E-03	mg/L	6	2
		Barium	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	5
		Benz(a)anthracene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzo(a)pyrene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzo(b)fluoranthene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzo(ghi)perylene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzo(k)fluoranthene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzoic acid	.	.	.	1.00E-02	1.00E-02	1.00E-02	mg/L	5	0
		Benzyl alcohol	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Beryllium	.	.	.	2.50E-03	2.50E-03	2.50E-03	mg/L	5	0
		Bis(2-chloroethoxy) methane	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bis(2-chloroethyl) ether	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bis(2-chloroisopropyl) ether	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bis(2-ethylhexyl) phthalate	.	.	.	1.40E-03	1.47E-02	5.41E-03	mg/L	5	0
		Bromodichloromethane	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bromoform	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bromomethane	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bromophenyl phenyl ether, 4-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Butylbenzyl phthalate	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Cadmium	8.64E+01	1.01E+02	9.22E+01	2.50E-03	2.50E-03	2.50E-03	mg/L	5	0
		Calcium	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	5
		Carbazole	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Carbon disulfide	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Carbon tetrachloride	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chlordane, alpha-	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Chlordane, gamma-	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Chlordane, total	.	.	.	1.50E-05	1.50E-05	1.50E-05	mg/L	5	0
		Chloro-3-methylphenol, 4-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chloroaniline, 4-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chlorobenzene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chloroethane	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Chloroethylvinyl ether, 2-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chloroform	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chloromethane	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chloronaphthalene, 2-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chlorophenol, 2-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chlorophenyl phenyl ether, 4-	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Chromium, total	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chrysene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Cobalt	.	.	.	1.00E-02	1.00E-02	1.00E-02	mg/L	5	0
		Copper	1.10E-05	1.10E-05	1.10E-05	2.50E-03	2.50E-03	2.50E-03	mg/L	5	0
		DDD, p,p'-	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	1
		DDT, p,p'-	.	.	.	3.50E-06	3.50E-06	3.50E-06	mg/L	5	0
		DDT, p,p'-	.	.	.	3.50E-06	3.50E-06	3.50E-06	mg/L	5	0
		Dalapon	.	.	.	5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Di-n-butyl phthalate	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Di-n-octyl phthalate	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dibenz(ah)anthracene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dibenzofuran	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dibromochloromethane	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0

d:\mary\ftsher2\surplus\drftfinl\bchra\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 16

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Background Ravine										
		Dicamba				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Dichlorobenzene, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichlorobenzene, 1,3-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichlorobenzene, 1,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichlorobenzidine, 3,3'-				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Dichloroethane, 1,1-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloroethane, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloroethene, 1,1-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloroethenes, 1,2-, total				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichlorophenol, 2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloropropane, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloropropene, 1,3-, cis-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloropropene, 1,3-, trans-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dieldrin				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Diethyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dimethyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dimethylphenol, 2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dinitro-2-methylphenol, 4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Dinitrobenzene, 1,3-				1.50E-02	1.50E-02	1.50E-02	mg/L	5	0
		Dinitrophenol, 2,4-				3.00E-05	3.00E-05	3.00E-05	mg/L	5	0
		Dinitrotoluene, 2,4-				3.50E-05	3.50E-05	3.50E-05	mg/L	5	0
		Dinitrotoluene, 2,6-				2.64E-03	2.64E-03	2.64E-03	mg/L	5	2
		Dinitrotoluene, 3,4-	5.40E-03	5.78E-03	5.59E-03	5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Dinoseb				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Endosulfan A				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Endosulfan B				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Endosulfan sulfate				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Endrin				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Endrin aldehyde				1.00E-05	1.00E-05	1.00E-05	mg/L	5	0
		Endrin ketone				3.00E-06	3.00E-06	3.00E-06	mg/L	5	0
		Ethylbenzene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Fluoranthene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Fluorene				1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		HMX				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Heptachlor				2.50E-06	2.50E-06	2.50E-06	mg/L	5	1
		Heptachlor epoxide				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Hexachlorobenzene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Hexachlorobutadiene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Hexachlorocyclohexane, alpha-				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Hexachlorocyclohexane, beta-				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Hexachlorocyclohexane, delta-				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Hexachlorocyclohexane, gamma-				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Hexachlorocyclopentadiene				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Hexachloroethane				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Indeno(1,2,3-cd)pyrene				2.25E-02	2.25E-02	2.25E-02	mg/L	5	0
		Iron	2.21E-01	1.22E+00	6.65E-01	1.00E-03	1.00E-03	1.00E-03	mg/L	5	3
		Isophorone				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Lead				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		MCPA				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		MCPP				1.50E-03	1.50E-03	1.50E-03	mg/L	5	0
		Magnesium	4.99E+01	6.38E+01	5.45E+01	2.50E-03	2.50E-03	2.50E-03	mg/L	5	5
		Manganese	2.31E-02	2.18E-01	8.36E-02	1.00E-04	1.00E-04	1.00E-04	mg/L	5	4
		Mercury				4.50E-06	4.50E-06	4.50E-06	mg/L	5	0
		Methoxychlor				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Methyl ethyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Methyl isobutyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Methyl n-butyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Methylene chloride				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Methylnaphthalene, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Methylnaphthalene, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Methylphenol, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Naphthalene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0

d:\mary\ftsher2\surplsou\drftfinl\bchravs\datasum\humdasum.1st

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Background Ravine	Nickel				7.50E-03	7.50E-03	7.50E-03	mg/L	5	0
		Nitroaniline, 2-				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Nitroaniline, 3-				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Nitroaniline, 4-				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Nitrobenzene				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Nitrophenol, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Nitrophenol, 4-				1.00E-02	1.00E-02	1.00E-02	mg/L	5	0
		Nitrosodi-N-propylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Nitrosodiphenylamine, N-				1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		Nitrotoluene, 2-				1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		Nitrotoluene, 3-				1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		Nitrotoluene, 4-				1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		PCB 1016				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		PCB 1221				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		PCB 1232				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		PCB 1242				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		PCB 1248				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		PCB 1254				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		PCB 1260				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		Pentachlorophenol				5.00E-03	5.00E-03	5.00E-03	mg/L	5	1
		Petroleum hydrocarbons, total (TPH)	1.82E-01	1.82E-01	1.82E-01	8.45E-02	8.45E-02	8.45E-02	mg/L	5	0
		Phenanthrene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Phenol				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Potassium	3.31E+00	4.56E+00	3.69E+00				mg/L	5	5
		Pyrene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		RD	2.57E-04	2.57E-04	2.57E-04				mg/L	5	1
		Selenium				1.25E-03	1.25E-03	1.25E-03	mg/L	5	0
		Silver				2.50E-03	2.50E-03	2.50E-03	mg/L	5	0
		Silver (2,4,5-TP)				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Sodium	2.47E+01	5.56E+01	4.12E+01				mg/L	5	5
		Styrene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Tetrachloroethane, 1,1,2,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Tetrachloroethene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Tetral				5.00E-04	5.00E-04	5.00E-04	mg/L	5	0
		Thallium				1.25E-03	1.25E-03	1.25E-03	mg/L	5	0
		Toluene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Toxaphene				3.00E-04	3.00E-04	3.00E-04	mg/L	5	0
		Trichlorobenzene, 1,2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Trichloroethane, 1,1,1-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Trichloroethane, 1,1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Trichloroethene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Trichlorophenol, 2,4,5-				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Trichlorophenol, 2,4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	5	1
		Trinitrobenzene, 1,3,5-				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Trinitrotoluene, 2,4,6-				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Vanadium	4.25E-04	4.25E-04	4.25E-04				mg/L	5	0
		Vinyl acetate				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Vinyl chloride				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Xylenes, total				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Zinc				1.00E-02	1.00E-02	1.00E-02	mg/L	5	0
Surface Water	Beach	2,4-D				4.01E-04	4.01E-04	4.01E-04	mg/L	1	0
		Acenaphthene				8.50E-04	8.50E-04	8.50E-04	mg/L	4	0
		Acenaphthylene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Acetone				6.50E-03	6.50E-03	6.50E-03	mg/L	4	0
		Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/L	4	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/L	4	0
		Aldrin				4.59E-05	4.59E-05	4.59E-05	mg/L	4	0
		Aluminum				7.05E-02	7.05E-02	7.05E-02	mg/L	4	0
		Anthracene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0

d:\mary\ftsher2\surplisou\drftfin\bcbravs\data\sum\hundaum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Beach										
		Antimony				1.90E-02	1.90E-02	1.90E-02	mg/L	4	0
		Arsenic				1.27E-03	1.27E-03	1.27E-03	mg/L	4	0
		Barium	2.44E-02	4.20E-02	3.53E-02				mg/L	4	4
		Benz(a)anthracene				8.00E-04	8.00E-04	8.00E-04	mg/L	4	0
		Benzene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Benzidine				5.00E-03	5.00E-03	5.00E-03	mg/L	4	0
		Benzo(a)pyrene				2.35E-03	2.35E-03	2.35E-03	mg/L	4	0
		Benzo(b)fluoranthene				2.70E-03	2.70E-03	2.70E-03	mg/L	4	0
		Benzo(ghi)perylene				3.05E-03	3.05E-03	3.05E-03	mg/L	4	0
		Benzo(k)fluoranthene				4.35E-04	4.35E-04	4.35E-04	mg/L	4	0
		Benzoic acid				6.50E-03	6.50E-03	6.50E-03	mg/L	4	0
		Benzyl alcohol				3.60E-04	3.60E-04	3.60E-04	mg/L	4	0
		Beryllium				2.50E-03	2.50E-03	2.50E-03	mg/L	4	0
		Bis(2-chloroethoxy) methane				7.50E-04	7.50E-04	7.50E-04	mg/L	4	0
		Bis(2-chloroethyl) ether				9.50E-04	9.50E-04	9.50E-04	mg/L	4	0
		Bis(2-chloroisopropyl) ether				2.65E-03	2.65E-03	2.65E-03	mg/L	4	0
		Bis(2-ethylhexyl) phthalate				2.40E-03	2.40E-03	2.40E-03	mg/L	4	0
		Bromodichloromethane				2.95E-04	2.95E-04	2.95E-04	mg/L	4	0
		Bromomethane				1.30E-03	1.30E-03	1.30E-03	mg/L	4	0
		Bromophenyl phenyl ether, 4-				2.90E-03	2.90E-03	2.90E-03	mg/L	4	0
		Butylbenzyl phthalate				2.10E-03	2.10E-03	2.10E-03	mg/L	4	0
		Cadmium				1.70E-03	1.70E-03	1.70E-03	mg/L	4	0
		Calcium	8.80E+01	1.30E+02	1.07E+02	2.01E-03	2.01E-03	2.01E-03	mg/L	4	0
		Carbon disulfide				2.50E-04	2.50E-04	2.50E-04	mg/L	4	4
		Carbon tetrachloride				2.90E-04	2.90E-04	2.90E-04	mg/L	4	0
		Chlordane, alpha-				2.55E-03	2.55E-03	2.55E-03	mg/L	4	0
		Chlordane, gamma-				2.55E-03	2.55E-03	2.55E-03	mg/L	4	0
		Chlordane, total				1.33E-04	1.33E-04	1.33E-04	mg/L	1	0
		Chloride	1.91E+01	1.20E+02	7.73E+01				mg/L	4	4
		Chloro-3-methylphenol, 4-				2.00E-03	2.00E-03	2.00E-03	mg/L	4	0
		Chloroaniline, 4-				3.65E-03	3.65E-03	3.65E-03	mg/L	4	0
		Chlorobenzene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Chloroethane				9.50E-04	9.50E-04	9.50E-04	mg/L	4	0
		Chloroethylvinyl ether, 2-				3.55E-04	3.55E-04	3.55E-04	mg/L	4	0
		Chloroform	1.60E-03	1.60E-03	1.60E-03	2.50E-04	2.50E-04	2.50E-04	mg/L	4	1
		Chloromethane				1.60E-03	1.60E-03	1.60E-03	mg/L	4	0
		Chloronaphthalene, 2-				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Chlorophenol, 2-				4.95E-04	4.95E-04	4.95E-04	mg/L	4	0
		Chlorophenyl phenyl ether, 4-				2.55E-03	2.55E-03	2.55E-03	mg/L	4	0
		Chromium, total				3.01E-03	3.01E-03	3.01E-03	mg/L	4	0
		Chrysene				1.20E-03	1.20E-03	1.20E-03	mg/L	4	0
		Cobalt				1.25E-02	1.25E-02	1.25E-02	mg/L	4	0
		Copper				4.05E-03	4.05E-03	4.05E-03	mg/L	4	0
		Cyanide, total				1.25E-03	1.25E-03	1.25E-03	mg/L	4	0
		DDD, p,p'-				1.17E-05	1.17E-05	1.17E-05	mg/L	4	0
		DDE, p,p'-				1.35E-05	1.35E-05	1.35E-05	mg/L	4	0
		DDT, p,p'-				1.70E-05	1.70E-05	1.70E-05	mg/L	4	0
		Di-n-butyl phthalate				1.85E-03	1.85E-03	1.85E-03	mg/L	4	0
		Di-n-octyl phthalate				7.50E-03	7.50E-03	7.50E-03	mg/L	4	0
		Dibenz(ah)anthracene				3.25E-03	3.25E-03	3.25E-03	mg/L	4	0
		Dibenzofuran				8.50E-04	8.50E-04	8.50E-04	mg/L	4	0
		Dibromochloromethane				3.35E-04	3.35E-04	3.35E-04	mg/L	4	0
		Dichlorobenzene, 1,2-				8.50E-04	8.50E-04	8.50E-04	mg/L	4	0
		Dichlorobenzene, 1,3-				8.50E-04	8.50E-04	8.50E-04	mg/L	4	0
		Dichlorobenzenes, total				5.00E-03	5.00E-03	5.00E-03	mg/L	4	0
		Dichlorobenzidine, 3,3'-				6.00E-03	6.00E-03	6.00E-03	mg/L	4	0
		Dichloroethane, 1,1-				3.40E-04	3.40E-04	3.40E-04	mg/L	4	0
		Dichloroethane, 1,2-				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0

cd:\mary\ftsher2\surplisou\drftfinl\bchra\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Beach										
		Dichloroethene, 1,1-				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Dichloroethenes, 1,2-, total				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Dichlorophenol, 2,4-				1.45E-03	1.45E-03	1.45E-03	mg/L	4	0
		Dichloropropane, 1,2-				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Dichloropropane, 1,3-, cis-				2.90E-04	2.90E-04	2.90E-04	mg/L	4	0
		Dichloropropane, 1,3-, trans-				3.50E-04	3.50E-04	3.50E-04	mg/L	4	0
		Dieldrin				1.20E-05	2.35E-03	1.77E-03	mg/L	4	0
		Diethyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	4	0
		Dimethyl phthalate				7.50E-04	7.50E-04	7.50E-04	mg/L	4	0
		Dimethylphenol, 2,4-				2.90E-03	2.90E-03	2.90E-03	mg/L	4	0
		Dinitro-2-methylphenol, 4,6-				8.50E-03	8.50E-03	8.50E-03	mg/L	4	0
		Dinitrobenzene, 1,3-				2.60E-04	2.60E-04	2.60E-04	mg/L	3	0
		Dinitrophenol, 2,4-				1.05E-02	1.05E-02	1.05E-02	mg/L	4	0
		Dinitrotoluene, 2,4-				3.06E-04	2.25E-03	7.92E-04	mg/L	4	0
		Dinitrotoluene, 2,6-				3.95E-04	3.95E-04	3.95E-04	mg/L	4	0
		Diphenylhydrazine, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	4	0
		Endosulfan A				1.15E-05	4.60E-03	3.45E-03	mg/L	4	0
		Endosulfan B				1.15E-05	4.60E-03	3.45E-03	mg/L	4	0
		Endosulfan sulfate				3.93E-05	4.60E-03	3.46E-03	mg/L	4	0
		Endrin				1.19E-05	3.80E-03	2.85E-03	mg/L	4	0
		Endrin aldehyde				1.43E-05	4.00E-03	3.00E-03	mg/L	4	0
		Endrin ketone				4.00E-03	4.00E-03	4.00E-03	mg/L	4	0
		Ethylbenzene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Fluoranthene				1.65E-03	1.65E-03	1.65E-03	mg/L	4	0
		Fluorene				1.85E-03	1.85E-03	1.85E-03	mg/L	4	0
		Fluoride				6.15E-01	6.15E-01	6.15E-01	mg/L	4	0
		HMX				8.25E-04	8.25E-04	8.25E-04	mg/L	3	0
		Heptachlor				2.12E-05	1.00E-03	7.55E-04	mg/L	4	0
		Heptachlor epoxide				1.23E-05	2.50E-03	1.88E-03	mg/L	4	0
		Hexachlorobenzene				8.00E-04	8.00E-04	8.00E-04	mg/L	4	0
		Hexachlorobutadiene				1.70E-03	1.70E-03	1.70E-03	mg/L	4	0
		Hexachlorocyclohexane, alpha-				1.93E-05	2.00E-03	1.50E-03	mg/L	4	0
		Hexachlorocyclohexane, beta-				1.20E-05	2.00E-03	1.50E-03	mg/L	4	0
		Hexachlorocyclohexane, delta-				1.47E-05	2.00E-03	1.50E-03	mg/L	4	0
		Hexachlorocyclohexane, gamma-				2.58E-05	2.00E-03	1.50E-03	mg/L	4	0
		(Lindane)				4.30E-03	4.30E-03	4.30E-03	mg/L	4	0
		Hexachlorocyclopentadiene				7.50E-04	7.50E-04	7.50E-04	mg/L	4	0
		Hexachloroethane				4.30E-03	4.30E-03	4.30E-03	mg/L	4	0
		Indeno(1,2,3-cd)pyrene				1.94E-02	1.94E-02	1.94E-02	mg/L	4	1
		Iron	9.66E-02	9.66E-02	9.66E-02	2.81E-05	2.81E-05	2.81E-05	mg/L	1	0
		Isodrin				2.40E-03	2.40E-03	2.40E-03	mg/L	4	0
		Isophorone				6.30E-04	6.30E-04	6.30E-04	mg/L	4	2
		Lead	1.41E-03	3.04E-03	2.23E-03				mg/L	4	4
		Magnesium	4.60E+01	5.30E+01	4.95E+01				mg/L	4	4
		Manganese	6.68E-02	2.83E-01	1.67E-01				mg/L	4	4
		Mercury				1.22E-04	1.22E-04	1.22E-04	mg/L	4	4
		Methoxychlor				2.85E-05	1.92E-03	1.92E-03	mg/L	4	0
		Methyl ethyl ketone				3.20E-03	3.20E-03	3.20E-03	mg/L	4	0
		Methyl isobutyl ketone				1.50E-03	1.50E-03	1.50E-03	mg/L	4	0
		Methyl n-butyl ketone				1.80E-03	1.80E-03	1.80E-03	mg/L	4	0
		Methylene chloride				1.15E-03	1.15E-03	1.15E-03	mg/L	4	0
		Methylnaphthalene, 2-				8.50E-04	8.50E-04	8.50E-04	mg/L	4	0
		Methylphenol, 2-				1.95E-03	1.95E-03	1.95E-03	mg/L	4	0
		Methylphenol, 4-				2.60E-04	2.60E-04	2.60E-04	mg/L	4	0
		Naphthalene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Nickel				1.72E-02	1.72E-02	1.72E-02	mg/L	4	0
		Nitroaniline, 2-				2.15E-03	2.15E-03	2.15E-03	mg/L	4	0
		Nitroaniline, 3-				2.45E-03	2.45E-03	2.45E-03	mg/L	4	0
		Nitroaniline, 4-				2.60E-03	2.60E-03	2.60E-03	mg/L	4	0
		Nitrobenzene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Nitrogen, NO2+NO3				5.00E-03	5.00E-03	5.00E-03	mg/L	4	3
		Nitrophenol, 2-				1.85E-03	1.85E-03	1.85E-03	mg/L	4	0
		Nitrophenol, 4-				6.00E-03	6.00E-03	6.00E-03	mg/L	4	0
		Nitrosodi-N-propylamine, N-				2.20E-03	2.20E-03	2.20E-03	mg/L	4	0

d:\mary\fshe2\surpl\ou\drft\fin\bchra\bra\datasum\hmdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Beach	Nitrosodimethylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	4	0
		Nitrosodiphenylamine, N-				1.50E-03	1.50E-03	1.50E-03	mg/L	4	0
		Organic carbon, total (TOC)	5.00E+00	1.12E+03	2.85E+02				mg/L	4	0
		PCB 1016				8.00E-05	1.05E-02	7.90E-03	mg/L	4	0
		PCB 1221				8.00E-05	1.05E-02	7.90E-03	mg/L	4	0
		PCB 1232				8.00E-05	1.05E-02	7.90E-03	mg/L	4	0
		PCB 1242				8.00E-05	1.05E-02	7.90E-03	mg/L	4	0
		PCB 1248				8.00E-05	1.05E-02	7.90E-03	mg/L	4	0
		PCB 1254				8.00E-05	1.05E-02	7.90E-03	mg/L	4	0
		PCB 1260				8.00E-05	1.05E-02	7.90E-03	mg/L	4	0
		Pentachlorophenol				9.50E-05	1.80E-02	1.35E-02	mg/L	4	0
		Phenanthrene				9.50E-05	1.80E-02	1.35E-02	mg/L	4	0
		Phenol				9.50E-05	1.80E-02	1.35E-02	mg/L	4	0
		Potassium	2.63E+00	4.04E+00	3.10E+00	4.60E-03	4.60E-03	4.60E-03	mg/L	4	0
		Pyrene				1.40E-03	1.40E-03	1.40E-03	mg/L	4	0
		RDX				1.06E-03	1.06E-03	1.06E-03	mg/L	3	0
		Selenium				1.51E-03	1.51E-03	1.51E-03	mg/L	4	0
		Silver				1.25E-04	1.25E-04	1.25E-04	mg/L	4	0
		Silver (2,4,5-TP)				8.50E-05	8.50E-05	8.50E-05	mg/L	1	0
		Sodium	1.61E+01	5.09E+01	3.62E+01				mg/L	4	4
		Styrene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Sulfate	8.89E+01	2.69E+02	1.57E+02				mg/L	4	4
		Tetrachloroethane, 1,1,2,2-				2.55E-04	2.55E-04	2.55E-04	mg/L	4	0
		Tetrachloroethene				8.00E-04	8.00E-04	8.00E-04	mg/L	4	0
		Tetryl				2.78E-04	2.78E-04	2.78E-04	mg/L	3	0
		Toluene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Toxaphene				6.75E-04	1.80E-02	1.37E-02	mg/L	4	0
		Trichlorobenzene, 1,2,4-				9.00E-04	9.00E-04	9.00E-04	mg/L	4	0
		Trichloroethane, 1,1,1-				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Trichloroethane, 1,1,2-				6.00E-04	6.00E-04	6.00E-04	mg/L	4	0
		Trichloroethene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Trichlorofluoromethane				7.00E-04	7.00E-04	7.00E-04	mg/L	4	0
		Trichlorophenol, 2,4,5-				2.60E-03	2.60E-03	2.60E-03	mg/L	4	0
		Trichlorophenol, 2,4,6-				2.10E-03	2.10E-03	2.10E-03	mg/L	4	0
		Trinitrobenzene, 1,3,5-				3.13E-04	3.13E-04	3.13E-04	mg/L	3	0
		Trinitrobenzene, 2,4,6-				2.94E-04	2.94E-04	2.94E-04	mg/L	3	0
		Vanadium				1.91E-03	1.91E-03	1.91E-03	mg/L	4	0
		Vinyl acetate				4.15E-03	4.15E-03	4.15E-03	mg/L	4	0
		Vinyl chloride				1.30E-03	1.30E-03	1.30E-03	mg/L	4	0
		Xylenes, total				4.20E-04	4.20E-04	4.20E-04	mg/L	4	0
		Zinc				1.06E-02	1.06E-02	1.06E-02	mg/L	4	0
Surface Water	Hutchinson Ravine	2,4,5-T				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		2,4-D				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		2,4-DB				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Acenaphthene				8.50E-04	1.00E-03	9.89E-04	mg/L	14	0
		Acenaphthylene				2.50E-04	1.00E-03	9.46E-04	mg/L	14	0
		Acetone				5.00E-03	3.95E-02	1.01E-02	mg/L	7	0
		Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/L	1	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/L	1	0
		Aldrin				2.50E-06	2.50E-06	2.50E-06	mg/L	12	0
		Aluminum	5.42E-02	2.36E+00	8.08E-01	2.89E-02	8.90E-02	6.28E-02	mg/L	12	9
		Amino-2,6-dinitrotoluene, 4-				5.00E-05	5.00E-05	5.00E-05	mg/L	8	0
		Amino-4,6-dinitrotoluene, 2-				5.00E-05	5.00E-05	5.00E-05	mg/L	8	0
		Anthracene	1.36E-04	9.47E-04	4.30E-04	5.00E-05	5.00E-05	7.59E-04	mg/L	14	3
		Antimony				1.90E-02	2.50E-02	2.45E-02	mg/L	12	0
		Arsenic	2.70E-03	2.70E-03	2.70E-03	1.25E-03	1.27E-03	1.25E-03	mg/L	12	1
		Barium	4.71E-02	1.08E-01	7.27E-02				mg/L	12	12
		Benz(a)anthracene				1.00E-05	1.00E-03	6.32E-04	mg/L	14	0
		Benzene				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0

d:\mary\fisher2\surplusou\driftnal\bchravs\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Hutchinson Ravine	Benidine	1.47E-05	1.47E-05	1.47E-05	5.00E-03	5.00E-03	5.00E-03	mg/L	1	0
		Benzo(a)pyrene				5.00E-06	2.35E-03	7.98E-04	mg/L	14	1
		Benzo(b)fluoranthene				5.00E-05	2.70E-03	7.82E-04	mg/L	14	0
		Benzo(ghi)perylene				5.00E-05	3.05E-03	8.07E-04	mg/L	14	0
		Benzo(k)fluoranthene	8.75E-06	8.75E-06	8.75E-06	5.00E-06	1.00E-03	6.50E-04	mg/L	14	1
		Benzoic acid				6.50E-03	1.00E-02	9.71E-03	mg/L	12	0
		Benzyl alcohol				3.60E-04	1.00E-03	9.47E-04	mg/L	12	0
		Beryllium				2.50E-03	2.50E-03	2.50E-03	mg/L	12	0
		Bis(2-chloroethoxy) methane				7.50E-04	1.00E-03	9.79E-04	mg/L	12	0
		Bis(2-chloroethyl) ether				9.50E-04	1.00E-03	9.96E-04	mg/L	12	0
		Bis(2-chloroisopropyl) ether				1.00E-03	2.65E-03	1.14E-03	mg/L	12	0
		Bis(2-ethylhexyl) phthalate	2.70E-03	1.40E-02	8.35E-03	1.00E-03	2.40E-03	1.14E-03	mg/L	12	2
		Boron	1.05E-01	1.70E-01	1.36E-01	8.50E-02	8.50E-02	8.50E-02	mg/L	8	7
		Bromodichloromethane				2.95E-04	1.00E-03	8.99E-04	mg/L	7	0
		Bromoform				1.00E-03	1.30E-03	1.04E-03	mg/L	7	0
		Bromomethane				1.00E-03	2.90E-03	1.27E-03	mg/L	7	0
		Bromophenyl phenyl ether, 4-				1.00E-03	2.10E-03	1.09E-03	mg/L	12	0
		Butylbenzyl phthalate	3.00E-03	3.00E-03	3.00E-03	1.00E-03	1.70E-03	1.06E-03	mg/L	12	1
		Cadmium				2.01E-03	2.50E-03	2.46E-03	mg/L	12	0
		Calcium	9.79E+01	1.51E+02	1.19E+02	1.00E-03	1.00E-03	1.00E-03	mg/L	12	12
		Carbazole				1.00E-03	1.00E-03	1.00E-03	mg/L	11	0
		Carbon disulfide				2.50E-04	5.00E-03	4.32E-03	mg/L	7	0
		Carbon tetrachloride				2.90E-04	1.00E-03	8.99E-04	mg/L	7	0
		Chlordane, alpha-				2.50E-06	2.55E-03	2.15E-04	mg/L	12	0
		Chlordane, gamma-				2.50E-06	2.55E-03	2.15E-04	mg/L	12	0
		Chlordane, total				1.50E-05	1.50E-05	1.50E-05	mg/L	11	0
		Chloride	1.10E+02	1.00E+03	3.29E+02	1.00E-03	2.00E-03	1.08E-03	mg/L	9	9
		Chloro-3-methylphenol, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	12	0
		Chloroaniline, 4-				1.00E-03	3.65E-03	1.22E-03	mg/L	12	0
		Chlorobenzene				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Chloroethane				9.50E-04	5.00E-03	4.42E-03	mg/L	7	0
		Chloroethylvinyl ether, 2-				3.55E-04	5.00E-03	4.34E-03	mg/L	7	0
		Chloroform				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Chloromethane	1.20E-02	1.20E-02	1.20E-02	1.00E-03	1.60E-03	1.10E-03	mg/L	7	1
		Chloronaphthalene, 2-				2.50E-04	1.00E-03	9.38E-04	mg/L	12	0
		Chlorophenol, 2-				4.95E-04	1.00E-03	9.58E-04	mg/L	12	0
		Chlorophenyl phenyl ether, 4-				1.00E-03	2.55E-03	1.13E-03	mg/L	12	0
		Chromium, total				3.01E-03	5.00E-03	4.83E-03	mg/L	12	0
		Chrysene				5.00E-05	1.20E-03	6.75E-04	mg/L	14	0
		Cobalt				1.00E-02	1.25E-02	1.02E-02	mg/L	12	0
		Copper				2.50E-03	4.05E-03	2.63E-03	mg/L	12	0
		Cyanide, total	5.33E-03	5.33E-03	5.33E-03	1.25E-03	1.25E-03	1.25E-03	mg/L	12	1
		DDP, p,p'-	3.50E-05	1.10E-04	7.17E-05	2.50E-06	2.00E-03	3.35E-04	mg/L	12	6
		DDE, p,p'-	1.20E-05	1.20E-05	1.20E-05	3.50E-06	2.35E-03	2.17E-04	mg/L	12	1
		DDT, p,p'-	7.10E-06	2.00E-05	1.30E-05	3.50E-06	4.60E-03	5.78E-04	mg/L	12	4
		Dalepon				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Decachlorobiphenyl	2.17E-04	3.30E-04	2.65E-04	1.00E-03	1.85E-03	1.07E-03	mg/L	3	3
		Di-n-butyl phthalate				1.00E-03	7.50E-03	1.54E-03	mg/L	12	0
		Di-n-octyl phthalate				2.50E-05	3.25E-03	8.13E-04	mg/L	14	0
		Dibenz(ah)anthracene				8.50E-04	1.00E-03	9.88E-04	mg/L	12	0
		Dibenzofuran				3.35E-04	1.00E-03	9.05E-04	mg/L	7	0
		Dibromochloromethane				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Dicamba				8.50E-04	1.00E-03	9.88E-04	mg/L	12	0
		Dichlorobenzene, 1,2-				8.50E-04	1.00E-03	9.88E-04	mg/L	12	0
		Dichlorobenzene, 1,3-				8.50E-04	1.00E-03	9.88E-04	mg/L	12	0
		Dichlorobenzene, 1,4-				8.50E-04	1.00E-03	9.88E-04	mg/L	12	0
		Dichlorobenzenes, total				5.00E-03	5.00E-03	5.00E-03	mg/L	1	0
		Dichlorobenzidine, 3,3'-				5.00E-03	6.00E-03	5.08E-03	mg/L	12	0
		Dichloroethane, 1,1-				3.40E-04	1.00E-03	9.05E-04	mg/L	7	0
		Dichloroethane, 1,2-				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0

d:\mary\ftsher2\surplson\drftfinl\bchra\datasum\humdasum.lst



Appendix B1 Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BBA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Hutchinson Ravine										
		Dichloroethene, 1,1-				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Dichloroethenes, 1,2-, total				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Dichlorophenol, 2,4-				1.00E-03	1.45E-03	1.04E-03	mg/L	12	0
		Dichloropropane, 1,2-				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Dichloropropene, 1,3-, cis-				2.90E-04	1.00E-03	8.99E-04	mg/L	7	0
		Dichloropropene, 1,3-, trans-				3.50E-04	1.00E-03	9.07E-04	mg/L	7	0
		Dichloroprop				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0
		Dieldrin				2.50E-06	2.35E-03	1.98E-04	mg/L	12	0
		Diethyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	12	0
		Dimethyl phthalate				7.50E-04	1.00E-03	9.79E-04	mg/L	12	0
		Dimethylphenol, 2,4-				1.00E-03	2.90E-03	1.16E-03	mg/L	12	0
		Dinitro-2-methylphenol, 4,6-				5.50E-03	1.00E-02	9.88E-03	mg/L	12	0
		Dinitrobenzene, 1,3-				5.00E-05	5.00E-05	5.00E-05	mg/L	8	0
		Dinitrophenol, 2,4-				1.05E-02	1.50E-02	1.46E-02	mg/L	12	0
		Dinitrotoluene, 2,6-				3.00E-05	2.25E-03	4.58E-04	mg/L	12	0
		Dinitrotoluene, 2,6-				3.50E-05	1.00E-03	3.06E-04	mg/L	12	0
		Dinoseb				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Diphenylhydrazine, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	1	0
		Endosulfan A				2.50E-06	4.60E-03	3.86E-04	mg/L	12	0
		Endosulfan B				2.50E-06	4.60E-03	3.86E-04	mg/L	12	0
		Endosulfan sulfate				2.50E-06	4.60E-03	3.86E-04	mg/L	12	0
		Endrin				2.50E-06	3.80E-03	3.19E-04	mg/L	12	0
		Endrin aldehyde				1.00E-05	4.00E-03	3.43E-04	mg/L	12	0
		Endrin ketone				3.00E-06	4.00E-03	3.36E-04	mg/L	12	0
		Ethylbenzene				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Fluoranthene				1.00E-05	1.65E-03	8.79E-04	mg/L	14	0
		Fluorene				2.50E-04	1.85E-03	7.93E-04	mg/L	14	0
		Fluoride				2.50E-01	6.15E-01	2.96E-01	mg/L	9	1
		HMX				1.00E-04	1.00E-04	1.00E-04	mg/L	8	0
		Heptachlor				2.50E-06	1.00E-03	8.56E-05	mg/L	12	0
		Heptachlor epoxide				2.50E-06	2.50E-03	2.11E-04	mg/L	12	0
		Hexachlorobenzene				8.00E-04	1.00E-03	9.83E-04	mg/L	12	0
		Hexachlorocyclohexane, alpha-				1.00E-03	1.70E-03	1.06E-03	mg/L	12	0
		Hexachlorocyclohexane, beta-				2.50E-06	2.00E-03	1.69E-04	mg/L	12	0
		Hexachlorocyclohexane, delta-				2.50E-06	2.00E-03	1.69E-04	mg/L	12	0
		Hexachlorocyclohexane, gamma-				4.30E-03	5.00E-03	4.94E-03	mg/L	12	0
		Hexachlorocyclopentadiene				7.50E-04	1.00E-03	9.79E-04	mg/L	12	0
		Hexachlorocyclopentadiene				2.50E-05	4.30E-03	8.88E-04	mg/L	14	0
		Hexachlorocyclopentadiene				2.50E-05	4.30E-03	8.88E-04	mg/L	14	0
		Indeno(1,2,3-cd)pyrene				1.94E-02	1.94E-02	1.94E-02	mg/L	12	11
		Iron				1.00E-03	1.00E-03	1.00E-03	mg/L	12	0
		Isophorone				1.00E-03	2.40E-03	1.22E-03	mg/L	12	0
		Lead				6.30E-04	1.00E-03	9.47E-04	mg/L	12	5
		MCPA				1.50E-03	1.50E-03	1.50E-03	mg/L	6	0
		MCPP				1.50E-03	1.50E-03	1.50E-03	mg/L	6	0
		Magnesium				6.20E+01	6.20E+01	6.20E+01	mg/L	12	12
		Manganese				1.81E+00	5.55E-01	5.55E-01	mg/L	12	12
		Mercury				1.00E-04	1.22E-04	1.02E-04	mg/L	12	0
		Methoxychlor				4.50E-06	2.55E-03	2.17E-04	mg/L	12	0
		Methyl ethyl ketone				3.20E-03	5.00E-03	4.74E-03	mg/L	7	0
		Methyl isobutyl ketone				1.50E-03	5.00E-03	4.50E-03	mg/L	7	0
		Methyl n-butyl ketone				1.80E-03	5.00E-03	4.54E-03	mg/L	7	0
		Methylene chloride				1.15E-03	5.00E-03	4.45E-03	mg/L	7	0
		Methylnaphthalene, 1-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Methylnaphthalene, 2-				8.50E-04	1.00E-03	9.89E-04	mg/L	14	0
		Methylphenol, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	12	0
		Methylphenol, 4-				2.60E-04	1.00E-03	9.38E-04	mg/L	12	0
		Naphthalene				2.50E-04	1.00E-03	9.46E-04	mg/L	14	0
		Nickel				7.50E-03	1.72E-02	8.30E-03	mg/L	12	0
		Nitroaniline, 2-				2.15E-03	5.00E-03	4.76E-03	mg/L	12	0
		Nitroaniline, 3-				2.45E-03	5.00E-03	4.79E-03	mg/L	12	0
		Nitroaniline, 4-				5.00E-03	5.00E-03	4.80E-03	mg/L	12	0
		Nitrobenzene				5.00E-05	1.00E-03	3.04E-04	mg/L	12	0

d:\mary\ftsher2\surplou\drftfin\l\bchravs\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Hutchinson Ravine	Nitrogen, NO2+NO3	1.72E-01	9.20E-01	4.17E-01				mg/L	9	9
		Nitrophenol, 2-				1.00E-03	1.85E-03	1.07E-03	mg/L	12	0
		Nitrophenol, 4-				6.00E-03	1.00E-02	9.67E-03	mg/L	12	0
		Nitrosodi-N-propylamine, N-				1.00E-03	2.20E-03	1.10E-03	mg/L	12	0
		Nitrosodimethylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	1	0
		Nitrosodiphenylamine, N-				1.00E-03	1.00E-03	1.04E-03	mg/L	12	0
		Nitrotoluene, 2-				1.00E-04	1.50E-03	1.00E-04	mg/L	8	0
		Nitrotoluene, 3-				1.00E-04	1.00E-04	1.00E-04	mg/L	8	0
		Nitrotoluene, 4-				1.00E-04	1.00E-04	1.00E-04	mg/L	8	0
		Organic carbon, total (TOC)	3.93E+00	8.00E+01	1.56E+01	5.00E-01	5.00E-01	5.00E-01	mg/L	9	8
		PCB 1016				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1221				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1232				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1242				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1248				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1254				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1260				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		Pentachlorophenol				5.00E-03	9.00E-03	5.33E-03	mg/L	12	0
		Phenanthrene				2.50E-04	1.00E-03	6.79E-04	mg/L	14	0
		Phenol				1.00E-03	4.60E-03	1.30E-03	mg/L	12	0
		Potassium	3.44E+00	8.86E+00	5.18E+00	5.00E-05	1.40E-03	7.38E-04	mg/L	14	1
		Pyrene	2.80E-04	2.80E-04	2.80E-04	1.00E-04	1.00E-04	1.00E-04	mg/L	8	0
		RDX				1.25E-03	1.51E-03	1.27E-03	mg/L	12	0
		Selenium				1.25E-04	2.50E-03	2.30E-03	mg/L	12	0
		Silver				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Silvex (2,4,5-Tp)	3.99E+01	5.40E+02	1.66E+02	2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Sodium				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Styrene	1.90E+01	2.00E+02	1.16E+02	2.55E-04	1.00E-03	8.94E-04	mg/L	9	0
		Sulfate				8.00E-04	1.00E-03	9.71E-04	mg/L	7	0
		Tetrachloroethane, 1,1,2,2-				5.00E-04	5.00E-04	5.00E-04	mg/L	8	0
		Tetrachloroethene				1.25E-03	1.25E-03	1.25E-03	mg/L	11	0
		Tetryl				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Thallium				3.00E-04	1.80E-02	1.78E-03	mg/L	12	0
		Toluene				9.00E-04	1.00E-03	9.92E-04	mg/L	12	0
		Toxaphene				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Trichlorobenzene, 1,2,4-				6.00E-04	1.00E-03	9.43E-04	mg/L	7	0
		Trichloroethane, 1,1,1-				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Trichloroethane, 1,1,2-				7.00E-04	1.00E-04	7.00E-04	mg/L	1	0
		Trichloroethene				1.00E-03	2.60E-03	1.13E-03	mg/L	12	0
		Trichlorofluoromethane				1.00E-03	2.10E-03	1.09E-03	mg/L	12	0
		Trichlorophenol, 2,4,5-				5.00E-05	5.00E-05	5.00E-05	mg/L	8	0
		Trichlorophenol, 2,4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	8	0
		Trinitrobenzene, 1,3,5-				4.15E-03	5.00E-03	4.88E-03	mg/L	7	0
		Trinitrotoluene, 2,4,6-				1.00E-03	1.30E-03	1.04E-03	mg/L	7	0
		Vanadium				4.20E-04	5.00E-03	4.35E-03	mg/L	7	0
		Vinyl acetate				1.00E-02	1.00E-02	1.00E-02	mg/L	12	2
		Vinyl chloride									
		Xylenes, total									
		Zinc	2.01E-02	7.32E-02	4.67E-02						
Surface Water	Janes Ravine	2,4-D	1.41E-03	1.41E-03	1.41E-03	4.01E-04	4.01E-04	4.01E-04	mg/L	3	1
		Acenaphthene				8.50E-04	1.00E-03	9.50E-04	mg/L	9	0
		Acenaphthylene				2.50E-04	1.00E-03	7.50E-04	mg/L	9	0
		Acetone	1.40E-02	1.40E-02	1.40E-02	5.00E-03	6.50E-03	5.90E-03	mg/L	6	1
		Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/L	2	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/L	2	0
		Aldrin				2.50E-06	4.59E-05	2.11E-05	mg/L	7	0
		Aluminum	6.28E-02	5.40E+00	1.60E+00	7.05E-02	7.05E-02	7.05E-02	mg/L	9	6
		Amino-2,6-dinitrotoluene, 4-				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0
		Amino-4,6-dinitrotoluene, 2-				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0

d:\mary\fs\sher2\surplisou\drftfinl\bchra\datasum\hundaum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Janes Ravine	Anthracene				5.00E-05	1.00E-03	4.33E-04	mg/L	9	0
		Antimony				1.90E-02	2.50E-02	2.30E-02	mg/L	9	0
		Arsenic	2.70E-03	6.72E-03	4.71E-03	1.25E-03	1.27E-03	1.26E-03	mg/L	9	2
		Barium	1.55E-02	8.23E-02	5.09E-02	1.25E-02	1.25E-02	1.25E-02	mg/L	9	8
		Benz(a)anthracene				1.00E-05	1.00E-03	6.03E-04	mg/L	9	0
		Benzene				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Benzo(a)pyrene				5.00E-03	5.00E-03	5.00E-03	mg/L	2	0
		Benzo(b)fluoranthene				5.00E-06	1.12E-03	1.12E-03	mg/L	9	0
		Benzo(ghi)perylene				5.00E-05	2.70E-03	1.25E-03	mg/L	9	0
		Benzo(k)fluoranthene				5.00E-05	3.05E-03	1.37E-03	mg/L	9	0
		Benzoic acid				5.00E-06	1.00E-03	4.80E-04	mg/L	9	0
		Benzyl alcohol				6.50E-03	1.00E-02	8.83E-03	mg/L	9	0
		Beryllium				3.60E-04	1.00E-03	7.87E-04	mg/L	9	0
		Bis(2-chloroethoxy) methane				2.50E-03	2.50E-03	2.50E-03	mg/L	9	0
		Bis(2-chloroethyl) ether				7.50E-04	1.00E-03	9.17E-04	mg/L	9	0
		Bis(2-chloroisopropyl) ether				9.50E-04	1.00E-03	9.83E-04	mg/L	9	0
		Bis(2-ethylhexyl) phthalate				1.00E-03	1.55E-03	1.55E-03	mg/L	9	0
		Boron	1.14E-01	1.49E-01	1.32E-01	1.00E-03	2.40E-03	1.47E-03	mg/L	9	0
		Bromodichloromethane				2.95E-04	1.00E-03	6.48E-04	mg/L	4	4
		Bromoform				1.00E-03	1.15E-03	1.15E-03	mg/L	6	0
		Bromomethane				1.00E-03	2.90E-03	1.95E-03	mg/L	6	0
		Bromophenyl phenyl ether, 4-				1.00E-03	2.10E-03	1.37E-03	mg/L	9	0
		Butylbenzyl phthalate	2.10E-03	2.10E-03	2.10E-03	1.00E-03	1.70E-03	1.26E-03	mg/L	9	1
		Cadmium				2.01E-03	2.50E-03	2.34E-03	mg/L	9	0
		Calcium	2.90E+01	1.11E+02	7.85E+01	1.00E-03	1.00E-03	1.00E-03	mg/L	9	9
		Carbazole				1.00E-03	5.00E-03	2.63E-03	mg/L	6	0
		Carbon disulfide				2.50E-04	5.00E-03	6.45E-04	mg/L	6	0
		Carbon tetrachloride				2.90E-04	2.55E-03	8.52E-04	mg/L	6	0
		Chlordane, alpha-				2.50E-06	2.55E-03	8.52E-04	mg/L	6	0
		Chlordane, gamma-				2.50E-06	2.55E-03	8.52E-04	mg/L	6	0
		Chlordane, total				1.50E-05	1.33E-04	6.54E-05	mg/L	7	0
		Chloride	2.00E+01	4.80E+02	1.39E+02	1.00E-03	1.00E-03	1.33E-03	mg/L	9	7
		Chloro-3-methylphenol, 4-				1.00E-03	2.00E-03	1.33E-03	mg/L	9	0
		Chloroaniline, 4-				1.00E-03	3.65E-03	1.88E-03	mg/L	9	0
		Chlorobenzene				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Chloroethane				9.50E-04	5.00E-03	2.98E-03	mg/L	6	0
		Chloroethylvinyl ether, 2-				3.55E-04	5.00E-03	2.68E-03	mg/L	6	0
		Chloroform				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Chloromethane				1.00E-03	1.60E-03	1.30E-03	mg/L	6	0
		Chloronaphthalene, 2-				2.50E-04	1.00E-03	7.50E-04	mg/L	9	0
		Chlorophenol, 2-				4.95E-04	1.00E-03	8.32E-04	mg/L	9	0
		Chlorophenyl phenyl ether, 4-				1.00E-03	2.55E-03	1.52E-03	mg/L	9	0
		Chromium, total				3.01E-03	5.00E-03	4.34E-03	mg/L	9	0
		Chrysene				5.00E-05	1.20E-03	7.50E-04	mg/L	9	0
		Cobalt				1.00E-02	1.25E-02	1.08E-02	mg/L	9	0
		Copper	9.31E-03	1.19E-02	1.06E-02	2.50E-03	4.05E-03	2.94E-03	mg/L	9	2
		Cyanide, total				1.25E-03	1.25E-03	1.25E-03	mg/L	7	0
		DDD, P,p'-	6.20E-06	7.83E-05	3.55E-05	2.50E-06	1.17E-05	7.08E-06	mg/L	7	3
		DDE, P,p'-				3.50E-06	1.35E-05	7.79E-06	mg/L	7	0
		DDT, P,p'-	1.10E-05	1.05E-04	5.80E-05	3.50E-06	1.70E-05	8.90E-06	mg/L	7	2
		Di-n-butyl phthalate				1.00E-03	1.85E-03	1.28E-03	mg/L	9	0
		Di-n-octyl phthalate				1.00E-03	7.50E-03	3.17E-03	mg/L	9	0
		Dibenz(ah)anthracene				2.50E-05	3.25E-03	1.43E-03	mg/L	9	0
		Dibenzofuran				8.50E-04	1.00E-03	9.50E-04	mg/L	9	0
		Dibromochloromethane				3.35E-04	1.00E-03	6.68E-04	mg/L	6	0
		Dichlorobenzene, 1,2-				8.50E-04	1.00E-03	9.50E-04	mg/L	9	0
		Dichlorobenzene, 1,3-				8.50E-04	1.00E-03	9.50E-04	mg/L	9	0
		Dichlorobenzene, 1,4-				8.50E-04	1.00E-03	9.50E-04	mg/L	9	0
		Dichlorobenzenes, total				5.00E-03	5.00E-03	5.00E-03	mg/L	2	0

d:\mary\fisher2\surplsol\drftfin1\bchravs\datasumm\humdasum.1st

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BBA

12:02 Tuesday, March 3, 1998 25

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Janes Ravine										
		Dichlorobenzidine, 3,3'-				5.00E-03	6.00E-03	5.33E-03	mg/L	9	0
		Dichloroethane, 1,1-				3.40E-04	1.00E-03	6.70E-04	mg/L	6	0
		Dichloroethane, 1,2-				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Dichloroethene, 1,1-				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Dichloroethene, 1,2-, total				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Dichlorophenol, 2,4-				1.00E-03	1.45E-03	1.15E-03	mg/L	9	0
		Dichloropropane, 1,2-				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Dichloropropene, 1,3-, cis-				2.90E-04	1.00E-03	6.45E-04	mg/L	6	0
		Dichloropropene, 1,3-, trans-				3.50E-04	1.00E-03	6.75E-04	mg/L	6	0
		Dieldrin				1.00E-03	1.00E-03	1.00E-03	mg/L	7	0
		Diethyl phthalate				7.50E-04	1.00E-03	9.17E-04	mg/L	9	0
		Dimethyl phthalate				1.00E-03	2.90E-03	1.63E-03	mg/L	9	0
		Dimethylphenol, 2,4-				8.50E-03	1.00E-02	9.50E-03	mg/L	9	0
		Dinitro-2-methylphenol, 4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0
		Dinitrobenzene, 1,3-				1.05E-02	1.05E-02	1.05E-02	mg/L	9	0
		Dinitrophenol, 2,4-				3.00E-05	2.25E-03	1.09E-03	mg/L	9	0
		Dinitrotoluene, 2,4-				3.50E-05	1.00E-03	4.77E-04	mg/L	9	0
		Dinitrotoluene, 2,6-				1.00E-03	1.00E-03	1.00E-03	mg/L	2	0
		Diphenylhydrazine, 1,2-				2.50E-06	1.15E-05	6.36E-06	mg/L	7	0
		Endosulfan A				2.50E-06	1.15E-05	6.36E-06	mg/L	7	0
		Endosulfan B				2.50E-06	1.15E-05	6.36E-06	mg/L	7	0
		Endosulfan sulfate				2.50E-06	1.15E-05	6.36E-06	mg/L	7	0
		Endrin				1.00E-05	1.43E-05	1.18E-05	mg/L	7	0
		Endrin aldehyde				3.00E-06	4.00E-03	1.34E-03	mg/L	6	0
		Endrin ketone				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Ethylbenzene				1.00E-05	1.65E-03	8.87E-04	mg/L	9	0
		Fluorene				2.50E-04	1.85E-03	1.03E-03	mg/L	9	0
		Fluoride				2.50E-01	6.15E-01	4.06E-01	mg/L	7	0
		HMX				2.50E-06	2.12E-05	1.05E-05	mg/L	3	0
		Heptachlor				2.50E-06	1.23E-05	6.68E-06	mg/L	7	0
		Heptachlor epoxide				8.00E-04	1.00E-03	9.33E-04	mg/L	9	0
		Hexachlorobenzene				1.00E-03	1.70E-03	1.23E-03	mg/L	9	0
		Hexachlorobutadiene				2.50E-06	1.93E-05	9.68E-06	mg/L	7	0
		Hexachlorocyclohexane, alpha-				2.50E-06	1.20E-05	6.57E-06	mg/L	7	0
		Hexachlorocyclohexane, beta-				2.50E-06	1.47E-06	7.71E-06	mg/L	7	0
		Hexachlorocyclohexane, delta-				2.50E-06	2.54E-05	1.39E-05	mg/L	7	1
		Hexachlorocyclohexane, gamma-				4.30E-03	5.00E-03	4.77E-03	mg/L	9	0
		Hexachlorocyclopentadiene				7.50E-04	1.00E-03	9.17E-04	mg/L	9	0
		Hexachloroethane				2.50E-05	4.30E-03	1.78E-03	mg/L	9	0
		Indeno(1,2,3-cd)pyrene				1.94E-02	1.94E-02	1.94E-02	mg/L	9	8
		Iron	4.72E-02	4.90E+00	1.23E+00	2.81E-05	2.81E-05	2.81E-05	mg/L	3	0
		Isodrin				1.00E-03	2.40E-03	1.47E-03	mg/L	9	0
		Isophorone				1.00E-03	1.00E-03	1.00E-03	mg/L	9	6
		Lead				3.56E-03	2.50E-03	2.50E-03	mg/L	9	9
		Magnesium	1.84E-03	6.50E-03	3.56E-03	4.76E+01	2.50E-03	2.50E-03	mg/L	9	8
		Manganese	9.89E+00	7.20E+01	4.76E+01	1.13E-02	1.29E-01	1.22E-04	mg/L	8	1
		Mercury	3.17E-04	3.17E-04	3.17E-04	3.17E-04	4.50E-06	1.06E-04	mg/L	7	0
		Methoxychlor				3.20E-03	5.00E-03	1.48E-05	mg/L	6	0
		Methyl ethyl ketone				1.50E-03	5.00E-03	3.25E-03	mg/L	6	0
		Methyl isobutyl ketone				1.80E-03	5.00E-03	3.40E-03	mg/L	6	0
		Methyl n-butyl ketone				1.15E-03	5.00E-03	3.08E-03	mg/L	6	0
		Methylene chloride				1.00E-03	1.00E-03	1.00E-03	mg/L	3	0
		Methylnaphthalene, 1-				8.50E-04	1.00E-03	9.50E-04	mg/L	9	0
		Methylnaphthalene, 2-				1.00E-03	1.95E-03	1.32E-03	mg/L	9	0
		Methylphenol, 2-				2.60E-04	1.00E-03	7.53E-04	mg/L	9	0
		Methylphenol, 4-				2.50E-04	1.00E-03	7.50E-04	mg/L	9	0
		Naphthalene				7.50E-03	1.72E-02	1.07E-02	mg/L	9	0
		Nickel				2.15E-03	5.00E-03	4.05E-03	mg/L	9	0
		Nitroaniline, 2-				2.45E-03	5.00E-03	4.15E-03	mg/L	9	0
		Nitroaniline, 3-				2.60E-03	5.00E-03	4.20E-03	mg/L	9	0
		Nitroaniline, 4-				5.00E-05	1.00E-03	4.33E-04	mg/L	9	0
		Nitrobenzene							mg/L	9	0

d:\mary\ftsher2\surplou\drffin\l\bchravs\datasum\humdasum.lst

Appendix B1. Human Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Janes Ravine										
		Nitrogen, NO2+NO3	4.99E-02	6.60E-01	2.79E-01	1.00E-03	1.85E-03	1.28E-03	mg/L	7	7
		Nitrophenol, 2-				6.00E-03	1.00E-02	8.67E-03	mg/L	9	0
		Nitrophenol, 4-				1.00E-03	2.20E-03	1.40E-03	mg/L	9	0
		Nitrosodi-N-propylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	2	0
		Nitrosodimethylamine, N-				1.00E-03	1.50E-03	1.17E-03	mg/L	9	0
		Nitrosodiphenylamine, N-				1.00E-04	1.00E-04	1.00E-04	mg/L	3	0
		Nitrotoluene, 2-				1.00E-04	1.00E-04	1.00E-04	mg/L	3	0
		Nitrotoluene, 3-				1.00E-04	1.00E-04	1.00E-04	mg/L	3	0
		Nitrotoluene, 4-				1.00E-04	1.00E-04	1.00E-04	mg/L	7	7
		Organic carbon, total (TOC)	2.00E+00	8.00E+00	4.35E+00	6.50E-05	8.00E-05	7.14E-05	mg/L	7	0
		PCB 1016				6.50E-05	8.00E-05	7.00E-05	mg/L	6	0
		PCB 1221				6.50E-05	8.00E-05	7.00E-05	mg/L	6	0
		PCB 1232				6.50E-05	9.50E-05	7.50E-05	mg/L	6	0
		PCB 1242				6.50E-05	9.50E-05	7.50E-05	mg/L	6	0
		PCB 1248				6.50E-05	9.50E-05	7.50E-05	mg/L	6	0
		PCB 1254				6.50E-05	9.50E-05	7.50E-05	mg/L	7	0
		PCB 1260				6.50E-05	9.50E-05	7.79E-05	mg/L	9	0
		Pentachlorophenol				5.00E-03	6.33E-03	6.33E-03	mg/L	9	0
		Phenanthrene				2.50E-04	1.00E-03	5.00E-04	mg/L	9	0
		Phenol				1.00E-03	4.60E-03	2.20E-03	mg/L	9	0
		Potassium	1.14E+00	2.30E+01	5.32E+00	5.00E-05	1.40E-03	8.17E-04	mg/L	9	9
		Pyrene				1.00E-04	1.00E-04	1.00E-04	mg/L	3	0
		RDX				1.25E-03	1.51E-03	1.34E-03	mg/L	9	0
		Selenium				1.25E-04	2.50E-03	1.71E-03	mg/L	9	0
		Silver				8.50E-05	8.50E-05	8.50E-05	mg/L	3	0
		Silvex (2,4,5-TP)				2.50E-04	1.00E-03	6.25E-04	mg/L	9	9
		Sodium	8.02E+00	2.27E+02	5.27E+01	2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Styrene				2.55E-04	1.00E-03	6.28E-04	mg/L	7	7
		Sulfate	1.23E+01	1.70E+02	1.10E+02	8.00E-04	1.00E-03	9.00E-04	mg/L	6	0
		Tetrachloroethane, 1,1,2,2-				5.00E-04	5.00E-04	5.00E-04	mg/L	3	0
		Tetrachloroethene				1.25E-03	1.25E-03	1.25E-03	mg/L	5	0
		Tetryl				2.50E-04	1.00E-03	7.00E-04	mg/L	6	1
		Thallium	1.20E-03	1.20E-03	1.20E-03	3.00E-04	6.75E-04	4.61E-04	mg/L	7	0
		Toluene				9.00E-04	1.00E-03	9.67E-04	mg/L	9	0
		Toxaphene				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Trichlorobenzene, 1,2,4-				6.00E-04	1.00E-03	8.00E-04	mg/L	6	0
		Trichloroethane, 1,1,1-				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Trichloroethane, 1,1,2-				7.00E-04	1.00E-03	6.25E-04	mg/L	6	0
		Trichloroethene				2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Trichlorofluoromethane				1.00E-03	2.60E-03	1.53E-03	mg/L	3	0
		Trichlorophenol, 2,4,5-				1.00E-03	2.10E-03	1.37E-03	mg/L	9	0
		Trichlorophenol, 2,4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0
		Trinitrobenzene, 1,3,5-				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0
		Trinitrotoluene, 2,4,6-				1.91E-03	5.00E-03	3.84E-03	mg/L	2	2
		Triphenylene	3.96E-03	4.09E-03	4.03E-03	4.15E-03	5.00E-03	4.59E-03	mg/L	9	1
		Vanadium	1.13E-02	1.13E-02	1.13E-02	1.00E-03	1.30E-03	1.15E-03	mg/L	6	0
		Vinyl acetate				4.20E-04	5.00E-03	2.71E-03	mg/L	6	0
		Vinyl chloride				1.00E-02	1.06E-02	1.01E-02	mg/L	9	4
		Xylenes, total	2.38E-02	3.73E-01	1.56E-01						
		Zinc									

d:\mary\fisher2\surplisou\drftfinl\bchravs\datasum\humdasum.lst  
c:\proj\sheridan\surplisou\beachrav\hraz\append52\humdasum.lst

## **Appendix B2**

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 1

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Groundwater	Background	2,4,5-T				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		2,4-D				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		2,4-DB				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Acenaphthene				1.00E-03	1.00E-03	1.00E-03	mg/L	11	0
		Acenaphthylene				1.00E-03	1.00E-03	1.00E-03	mg/L	11	0
		Acetone				5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Aldrin				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Aluminum	1.09E+00	1.52E+01	3.95E+00				mg/L	9	9
		Amino-2,6-dinitrotoluene, 4-				5.00E-05	5.00E-05	5.00E-05	mg/L	9	0
		Amino-4,6-dinitrotoluene, 2-				5.00E-05	5.00E-05	5.00E-05	mg/L	9	0
		Anthracene	1.05E-04	8.13E-04	4.59E-04	5.00E-05	5.00E-05	5.78E-04	mg/L	11	2
		Antimony				2.50E-02	2.50E-02	2.50E-02	mg/L	9	0
		Arsenic	3.60E-03	5.50E-03	4.57E-03	1.25E-03	1.25E-03	1.25E-03	mg/L	9	3
		Barium	3.15E-02	9.41E-02	4.80E-02				mg/L	9	9
		Benz(a)anthracene				1.00E-05	1.00E-05	4.60E-04	mg/L	11	0
		Benzene				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Benzo(a)pyrene				5.00E-06	1.00E-03	4.57E-04	mg/L	11	0
		Benzo(b)fluoranthene				5.00E-05	1.00E-03	4.82E-04	mg/L	11	0
		Benzo(ghi)perylene				5.00E-05	1.00E-03	4.82E-04	mg/L	11	0
		Benzo(k)fluoranthene				5.00E-06	1.00E-03	4.57E-04	mg/L	11	0
		Benzoic acid				1.00E-02	1.00E-02	1.00E-02	mg/L	9	0
		Benzyl alcohol				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Beryllium				2.50E-03	2.50E-03	2.50E-03	mg/L	9	0
		Bis(2-chloroethoxy) methane				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Bis(2-chloroethyl) ether				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Bis(2-chloroisopropyl) ether				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Bis(2-ethylhexyl) phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Boron	8.46E-02	6.86E-01	5.10E-01	2.50E-02	2.50E-02	2.50E-02	mg/L	9	7
		Bromodichloromethane				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Bromoform				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Bromomethane				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Bromophenyl phenyl ether, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Butylbenzyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Cadmium				2.50E-03	2.50E-03	2.50E-03	mg/L	9	0
		Calcium	5.36E+01	1.45E+02	8.79E+01				mg/L	9	9
		Carbazole				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Carbon disulfide				5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Carbon tetrachloride				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Chlordane, alpha-				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Chlordane, gamma-				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Chlordane, total				1.50E-05	1.50E-05	1.50E-05	mg/L	10	0
		Chloride	5.70E+00	1.80E+01	1.00E+01				mg/L	9	9
		Chloro-3-methylphenol, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Chloroaniline, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Chlorobenzene				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Chloroethane				5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Chloroethylvinyl ether, 2-				5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Chloroform				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Chloromethane				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Chloronaphthalene, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Chlorophenol, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Chlorophenyl phenyl ether, 4-				5.00E-03	5.00E-03	5.00E-03	mg/L	9	1
		Chromium, total	2.00E-02	2.00E-02	2.00E-02	5.00E-03	5.00E-03	5.00E-03	mg/L	11	1
		Chrysene	1.25E-04	1.25E-04	1.25E-04	1.00E-05	1.00E-05	1.00E-05	mg/L	9	0
		Cobalt	5.03E-03	1.63E-02	9.24E-03	1.00E-02	1.00E-02	1.00E-02	mg/L	9	0
		Copper				1.25E-03	1.25E-03	1.25E-03	mg/L	9	0
		Cyanide, total				2.50E-03	2.50E-03	2.50E-03	mg/L	9	0
		DDD, p,p'-				1.25E-03	1.25E-03	1.25E-03	mg/L	10	0
		DDE, p,p'-				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		DDT, p,p'-				3.50E-06	3.50E-06	3.50E-06	mg/L	10	0
		Dalapon				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Di-n-butyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Di-n-octyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0

d:\mary\ftsher2\surplisou\drftfinl\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 2

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Groundwater	Background										
		Dibenz(ah)anthracene				2.50E-05	1.00E-03	4.68E-04	mg/L	11	0
		Dibenzofuran				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Dibromochloromethane				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Dicamba				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Dichlorobenzene, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Dichlorobenzene, 1,3-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Dichlorobenzene, 1,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Dichlorobenzidine, 3,3'-				5.00E-03	5.00E-03	5.00E-03	mg/L	9	0
		Dichloroethane, 1,1-				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Dichloroethane, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Dichloroethene, 1,1-				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Dichloroethenes, 1,2-, total				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Dichlorophenol, 2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Dichloropropane, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Dichloropropene, 1,3-, cis-				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Dichloropropene, 1,3-, trans-				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Dichloroprop				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Dieldrin				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Diethyl phthalate				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Dimethyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Dimethylphenol, 2,4-				1.00E-02	1.00E-02	1.00E-02	mg/L	9	0
		Dinitro-2-methylphenol, 4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	9	0
		Dinitrobenzene, 1,3-				1.50E-02	1.50E-02	1.50E-02	mg/L	9	0
		Dinitrophenol, 2,4-				3.00E-05	3.00E-05	3.00E-05	mg/L	9	0
		Dinitrotoluene, 2,4-				3.50E-05	3.50E-05	3.50E-05	mg/L	9	0
		Dinitrotoluene, 2,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Dinoseb				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Endosulfan A				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Endosulfan B				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Endosulfan sulfate				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Endrin				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Endrin aldehyde				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Endrin ketone				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Ethylbenzene				3.00E-06	3.00E-06	3.00E-06	mg/L	10	0
		Fluoranthene				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Fluorene				1.00E-05	1.00E-05	5.05E-04	mg/L	11	1
		Fluoride				2.50E-04	2.50E-04	5.91E-04	mg/L	11	0
		HMX				2.50E-01	2.50E-01	2.50E-01	mg/L	9	6
		Heptachlor				1.00E-04	1.00E-04	1.00E-04	mg/L	9	0
		Heptachlor epoxide				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Hexachlorobenzene				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Hexachlorobutadiene				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Hexachlorocyclohexane, alpha-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Hexachlorocyclohexane, beta-				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Hexachlorocyclohexane, delta-				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Hexachlorocyclohexane, gamma-				2.50E-06	2.50E-06	2.50E-06	mg/L	10	0
		Hexachlorocyclopentadiene				5.00E-03	5.00E-03	5.00E-03	mg/L	9	0
		Hexachloroethane				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Indeno(1,2,3-cd)pyrene				2.50E-05	1.00E-03	4.68E-04	mg/L	11	0
		Iron				1.00E+00	1.00E+00	1.00E+00	mg/L	9	9
		Isophorone				1.00E-03	1.00E-03	1.00E-03	mg/L	9	6
		Lead				2.10E-03	9.30E-03	4.17E-03	mg/L	9	6
		MCPA				1.50E-03	1.50E-03	1.50E-03	mg/L	6	0
		MCPP				1.50E-03	1.50E-03	1.50E-03	mg/L	6	0
		Magnesium				3.12E+01	1.11E+02	6.44E+01	mg/L	9	9
		Manganese				2.93E-02	4.26E-01	1.19E-01	mg/L	9	9
		Mercury							mg/L	9	9
		Methoxychlor				1.00E-04	1.00E-04	1.00E-04	mg/L	9	0
		Methyl ethyl ketone				4.50E-06	4.50E-06	4.50E-06	mg/L	10	0
		Methyl isobutyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Methyl n-butyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Methylene chloride				5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Methylnaphthalene, 1-				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0

d:\mary\fisher2\surplisou\drftin\l\bchra\datasum\ecodasum.lst



Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 3

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Groundwater	Background										
		Methylnaphthalene, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	11	0
		Methylphenol, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Methylphenol, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Naphthalene				1.00E-03	1.00E-03	1.00E-03	mg/L	11	0
		Nickel	2.28E-02	2.28E-02	2.28E-02	7.50E-03	7.50E-03	7.50E-03	mg/L	9	1
		Nitroaniline, 2-				5.00E-03	5.00E-03	5.00E-03	mg/L	9	0
		Nitroaniline, 3-				5.00E-03	5.00E-03	5.00E-03	mg/L	9	0
		Nitroaniline, 4-				5.00E-03	5.00E-03	5.00E-03	mg/L	9	0
		Nitrobenzene				5.00E-03	5.00E-03	5.00E-03	mg/L	9	0
		Nitrogen, NO2+NO3				5.00E-05	5.00E-05	5.00E-05	mg/L	9	0
		Nitrophenol, 2-	2.01E-01	2.00E+00	9.02E-01	1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Nitrophenol, 4-				1.00E-02	1.00E-02	1.00E-02	mg/L	9	0
		Nitrosodi-N-propylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Nitrosodiphenylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Nitrotoluene, 2-				1.00E-04	1.00E-04	1.00E-04	mg/L	9	0
		Nitrotoluene, 3-				1.00E-04	1.00E-04	1.00E-04	mg/L	9	0
		Nitrotoluene, 4-				1.00E-04	1.00E-04	1.00E-04	mg/L	9	0
		Organic carbon, total (TOC)				5.00E-01	5.00E-01	5.00E-01	mg/L	9	3
		PCB 1016	1.76E+00	2.53E+00	2.15E+00	6.50E-05	6.50E-05	6.50E-05	mg/L	10	0
		PCB 1221				6.50E-05	6.50E-05	6.50E-05	mg/L	10	0
		PCB 1232				6.50E-05	6.50E-05	6.50E-05	mg/L	10	0
		PCB 1242				6.50E-05	6.50E-05	6.50E-05	mg/L	10	0
		PCB 1248				6.50E-05	6.50E-05	6.50E-05	mg/L	10	0
		PCB 1254				6.50E-05	6.50E-05	6.50E-05	mg/L	10	0
		PCB 1260				6.50E-05	6.50E-05	6.50E-05	mg/L	10	0
		Pentachlorophenol				5.00E-03	5.00E-03	5.00E-03	mg/L	9	0
		Phenanthrene	7.31E-04	7.31E-04	7.31E-04	2.50E-04	1.00E-03	6.25E-04	mg/L	11	1
		Phenol				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Potassium	1.17E+00	8.65E+00	3.77E+00	5.00E-05	1.00E-03	5.25E-04	mg/L	11	1
		Pyrene	2.59E-04	2.59E-04	2.59E-04	1.00E-04	1.00E-04	1.00E-04	mg/L	9	1
		RDX	2.30E-04	2.30E-04	2.30E-04	1.25E-03	1.25E-03	1.25E-03	mg/L	9	0
		Selenium				2.50E-03	2.50E-03	2.50E-03	mg/L	9	0
		Silver				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Silvex (2,4,5-TP)							mg/L	9	9
		Sodium	3.41E+01	8.57E+01	5.01E+01	1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Styrene				1.00E-03	1.00E-03	1.00E-03	mg/L	9	9
		Sulfate	4.00E+01	3.90E+02	2.39E+02	1.00E-03	1.00E-03	1.00E-03	mg/L	9	9
		Tetrachloroethane, 1,1,2,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Tetrachloroethene				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Tetryl				5.00E-04	5.00E-04	5.00E-04	mg/L	9	0
		Thallium				1.25E-03	1.25E-03	1.25E-03	mg/L	9	0
		Toluene				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Toxaphene				3.00E-04	3.00E-04	3.00E-04	mg/L	10	0
		Trichlorobenzene, 1,2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Trichloroethane, 1,1,1-				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Trichloroethane, 1,1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Trichloroethene				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Trichlorophenol, 2,4,5-				1.00E-03	1.00E-03	1.00E-03	mg/L	9	0
		Trichlorophenol, 2,4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	9	0
		Trinitrobenzene, 1,3,5-				5.00E-05	5.00E-05	5.00E-05	mg/L	9	0
		Trinitrobenzene, 2,4,6-				5.00E-03	5.00E-03	5.00E-03	mg/L	9	1
		Vanadium	2.22E-02	2.22E-02	2.22E-02	5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Vinyl acetate				5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Vinyl chloride				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Xylenes, total				5.00E-03	5.00E-03	5.00E-03	mg/L	6	0
		Zinc	2.50E-02	4.35E-02	3.65E-02	1.00E-02	1.00E-02	1.00E-02	mg/L	9	3
Groundwater	Beach										
		2,4,5-T				5.00E-05	5.00E-05	5.00E-05	mg/L	32	0
		2,4-D				5.00E-05	5.00E-05	5.00E-05	mg/L	32	0
		2,4-DB				5.00E-05	5.00E-05	5.00E-05	mg/L	32	0

d:\mary\lsherz2\surplou\drftfin\lsherz\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Groundwater	Beach	Acenaphthene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	39	0
		Acenaphthylene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	39	0
		Acetone	3.20E-02	3.20E-02	3.20E-02	5.00E-03	5.00E-03	5.00E-03	mg/L	31	1
		Aldrin	4.66E-01	1.76E-02	2.01E+01	2.50E-06	2.50E-06	2.50E-06	mg/L	38	0
		Aluminum	1.77E-04	1.77E-04	1.77E-04	6.65E-02	6.65E-02	6.65E-02	mg/L	34	33
		Amino-2,6-dinitrotoluene, 4-	.	.	.	5.00E-05	5.00E-05	5.00E-05	mg/L	27	1
		Amino-4,6-dinitrotoluene, 2-	.	.	.	5.00E-05	5.00E-05	5.00E-05	mg/L	27	0
		Anthracene	2.53E-04	6.50E-04	4.28E-04	5.00E-05	2.88E-04	2.88E-04	mg/L	37	5
		Antimony	5.30E-02	5.30E-02	5.30E-02	2.50E-02	2.50E-02	2.50E-02	mg/L	34	1
		Arsenic	1.93E-03	4.15E-02	1.23E-02	1.25E-03	1.25E-03	1.25E-03	mg/L	34	23
		Barium	2.68E-02	1.03E+00	2.30E-01	1.25E-02	1.25E-02	1.25E-02	mg/L	34	30
		Benz(a)anthracene	2.22E-05	3.03E-05	2.62E-05	1.00E-05	1.00E-05	1.00E-05	mg/L	39	3
		Benzene	1.26E-05	5.42E-05	2.95E-05	1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Benzo(a)pyrene	.	.	.	5.00E-06	1.00E-03	2.23E-04	mg/L	39	7
		Benzo(b)fluoranthene	.	.	.	5.00E-05	1.00E-03	2.21E-04	mg/L	39	0
		Benzo(ghi)perylene	1.10E-04	1.10E-04	1.10E-04	5.00E-05	1.00E-03	2.25E-04	mg/L	39	1
		Benzo(k)fluoranthene	1.74E-05	2.13E-05	1.94E-05	5.00E-06	1.00E-03	1.98E-04	mg/L	39	3
		Benzoic acid	.	.	.	1.00E-02	1.00E-02	1.00E-02	mg/L	33	0
		Benzyl alcohol	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Beryllium	1.75E-02	1.75E-02	1.75E-02	2.50E-03	2.50E-03	2.50E-03	mg/L	34	1
		Bis(2-chloroethoxy) methane	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Bis(2-chloroethyl) ether	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Bis(2-chloroisopropyl) ether	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Bis(2-ethylhexyl) phthalate	2.10E-03	2.70E-03	2.33E-03	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Boron	6.46E-02	1.02E+00	4.10E-01	1.00E-03	6.00E-03	1.34E-03	mg/L	33	3
		Bromodichloromethane	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	33
		Bromoform	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Bromomethane	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Bromophenyl phenyl ether, 4-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Butylbenzyl phthalate	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Cadmium	.	.	.	2.50E-03	2.50E-03	2.50E-03	mg/L	34	0
		Calcium	3.21E+01	5.88E+02	1.78E+02	1.00E-03	1.00E-03	1.00E-03	mg/L	34	34
		Carbazole	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Carbon disulfide	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	31	0
		Carbon tetrachloride	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Chlordane, alpha-	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	38	0
		Chlordane, gamma-	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	38	0
		Chlordane, total	.	.	.	1.50E-05	1.50E-05	1.50E-05	mg/L	38	0
		Chloride	4.60E+00	1.10E+03	9.87E+01	1.00E-03	1.00E-03	1.00E-03	mg/L	34	34
		Chloro-3-methylphenol, 4-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Chloroaniline, 4-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Chlorobenzene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Chloroethane	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	31	0
		Chloroethylvinyl ether, 2-	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	31	0
		Chloroform	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Chloromethane	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Chloronaphthalene, 2-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Chlorophenol, 2-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Chlorophenyl phenyl ether, 4-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Chromium, total	1.03E-02	2.65E-01	6.00E-02	5.00E-03	5.00E-03	5.00E-03	mg/L	34	17
		Chrysene	.	.	.	1.00E-05	1.00E-05	2.21E-04	mg/L	39	0
		Cobalt	2.56E-02	1.08E-01	6.22E-02	1.00E-02	1.00E-02	1.00E-02	mg/L	34	7
		Copper	4.47E-03	2.38E-01	4.86E-02	2.50E-03	2.50E-03	2.50E-03	mg/L	34	23
		Cyanide, total	9.70E-06	2.40E-05	1.49E-05	1.25E-03	1.25E-03	1.25E-03	mg/L	34	0
		DDD, p,p'-	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	38	3
		DDE, p,p'-	.	.	.	3.50E-06	3.50E-06	3.50E-06	mg/L	38	0
		DDT, p,p'-	2.50E-05	2.50E-05	2.50E-05	5.00E-05	5.00E-05	5.00E-05	mg/L	32	1
		Dalapon	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Di-n-butyl phthalate	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Di-n-octyl phthalate	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0

d:\mary\ftsher2\surplsou\drftfin\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 5

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Groundwater	Beach										
		Dibenz (ah) anthracene				2.50E-05	1.00E-03	2.00E-04	mg/L	39	0
		Dibenzofuran				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Dibromochloromethane				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dicamba				5.00E-05	5.00E-05	5.00E-05	mg/L	32	0
		Dichlorobenzene, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Dichlorobenzene, 1,3-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Dichlorobenzene, 1,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Dichlorobenzidine, 3,3'-				5.00E-03	5.00E-03	5.00E-03	mg/L	33	0
		Dichloroethane, 1,1-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dichloroethane, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dichloroethene, 1,1-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dichloroethenes, 1,2-, total				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dichlorophenol, 2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Dichloropropane, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dichloropropene, 1,3-, cis-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dichloropropene, 1,3-, trans-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dichloroprop				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dieldrin				5.00E-05	5.00E-05	5.00E-05	mg/L	32	0
		Diethyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Dimethyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Dimethylphenol, 2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Dinitro-2-methylphenol, 4,6-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dinitrobenzene, 1,3-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dinitrophenol, 2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dinitrotoluene, 2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Dinitrotoluene, 2,6-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	1
		Endosulfan A				3.50E-05	1.00E-03	2.10E-04	mg/L	33	0
		Endosulfan B				5.00E-05	5.00E-05	5.00E-05	mg/L	32	0
		Endosulfan sulfate				2.50E-06	2.50E-06	2.50E-06	mg/L	38	0
		Endrin				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Endrin aldehyde				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Endrin ketone				1.00E-02	1.00E-02	1.00E-02	mg/L	33	0
		Ethylbenzene				5.00E-05	5.00E-05	5.00E-05	mg/L	27	0
		Fluoranthene				1.50E-02	1.50E-02	1.50E-02	mg/L	33	0
		Fluorene				3.00E-05	1.00E-03	2.12E-04	mg/L	33	1
		Fluoride				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		HMX				2.50E-01	2.50E-01	2.50E-01	mg/L	34	17
		Heptachlor				2.50E-01	2.50E-01	2.50E-01	mg/L	27	0
		Heptachlor epoxide				1.00E-04	1.00E-04	1.00E-04	mg/L	34	0
		Hexachlorobenzene				2.50E-06	2.50E-06	2.50E-06	mg/L	38	0
		Hexachlorobutadiene				2.50E-06	2.50E-06	2.50E-06	mg/L	38	0
		Hexachlorocyclohexane, alpha-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Hexachlorocyclohexane, beta-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Hexachlorocyclohexane, delta-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Hexachlorocyclohexane, gamma-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Hexachlorocyclopentadiene				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Hexachloroethane				5.00E-03	5.00E-03	5.00E-03	mg/L	33	0
		Indeno(1,2,3-cd)pyrene				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Iron				2.50E-05	1.00E-03	2.20E-04	mg/L	39	4
		Isophorone				1.00E-03	1.00E-03	1.00E-03	mg/L	34	34
		Lead				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		MCPA				1.00E-03	1.00E-03	1.00E-03	mg/L	34	29
		MCPP				1.50E-03	1.50E-03	1.50E-03	mg/L	32	0
		Magnesium							mg/L	34	34
		Manganese							mg/L	34	34
		Mercury							mg/L	34	3
		Methoxychlor				1.00E-04	1.00E-04	1.00E-04	mg/L	34	0
		Methyl ethyl ketone				4.50E-06	4.50E-06	4.50E-06	mg/L	38	0
		Methyl isobutyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/L	31	0
		Methyl n-butyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/L	31	0
		Methylene chloride				5.00E-03	5.00E-03	5.00E-03	mg/L	31	0
		Methylnaphthalene, 1-				5.00E-03	5.00E-03	5.00E-03	mg/L	31	0

d:\mary\fta2\surplus\drftfinl\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Groundwater	Beach										
		Methylnaphthalene, 2-	3.04E-03	3.80E-03	3.42E-03	1.00E-03	1.00E-03	1.00E-03	mg/L	39	2
		Methylphenol, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Methylphenol, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Naphthalene				1.00E-03	1.00E-03	1.00E-03	mg/L	39	0
		Nickel	1.52E-02	2.65E-01	6.64E-02	7.50E-03	7.50E-03	7.50E-03	mg/L	34	17
		Nitroaniline, 2-				5.00E-03	5.00E-03	5.00E-03	mg/L	33	0
		Nitroaniline, 3-				5.00E-03	5.00E-03	5.00E-03	mg/L	33	0
		Nitroaniline, 4-				5.00E-03	5.00E-03	5.00E-03	mg/L	33	0
		Nitrobenzene				5.00E-03	5.00E-03	5.00E-03	mg/L	33	0
		Nitrogen, NO2+NO3				5.00E-05	5.00E-05	5.00E-05	mg/L	33	0
		Nitrophenol, 2-	3.72E-02	2.80E+00	4.86E-01	1.00E-02	1.00E-02	1.00E-02	mg/L	34	27
		Nitrophenol, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Nitrosodi-N-propylamine, N-				1.00E-02	1.00E-02	1.00E-02	mg/L	33	0
		Nitrosodiphenylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Nitrotoluene, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Nitrotoluene, 3-				1.00E-04	1.00E-04	1.00E-04	mg/L	27	0
		Nitrotoluene, 4-				1.00E-04	1.00E-04	1.00E-04	mg/L	27	0
		Organic carbon, total (TOC)				1.00E-04	1.00E-04	1.00E-04	mg/L	27	0
		PCB 1016	7.95E-01	7.40E+00	2.52E+00	5.00E-01	5.00E-01	5.00E-01	mg/L	34	24
		PCB 1221				6.50E-05	6.50E-05	6.50E-05	mg/L	38	0
		PCB 1232				6.50E-05	6.50E-05	6.50E-05	mg/L	38	0
		PCB 1242				6.50E-05	6.50E-05	6.50E-05	mg/L	38	0
		PCB 1248				6.50E-05	6.50E-05	6.50E-05	mg/L	38	0
		PCB 1254				6.50E-05	6.50E-05	6.50E-05	mg/L	38	0
		PCB 1260				6.50E-05	6.50E-05	6.50E-05	mg/L	38	0
		Pentachlorophenol				6.50E-05	6.50E-05	6.50E-05	mg/L	38	0
		Phenanthrene	7.62E-04	7.62E-04	7.62E-04	5.00E-03	5.00E-03	5.00E-03	mg/L	33	0
		Phenol				2.50E-04	2.50E-04	2.50E-04	mg/L	39	1
		Potassium	1.41E+00	5.75E+01	8.71E+00	1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Pyrene	1.08E-04	1.33E-04	1.21E-04	5.00E-05	5.00E-05	5.00E-05	mg/L	39	3
		RDX				1.00E-04	1.00E-04	1.00E-04	mg/L	27	0
		Selenium				1.25E-03	2.50E-03	1.36E-03	mg/L	34	0
		Silver				2.50E-03	2.50E-03	2.50E-03	mg/L	34	0
		Silvex (2,4,5-TP)				5.00E-05	5.00E-05	5.00E-05	mg/L	32	0
		Sodium	4.96E+00	8.20E+02	8.55E+01				mg/L	34	34
		Styrene				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Sulfate	2.50E+01	7.00E+02	2.90E+02				mg/L	34	34
		Tetrachloroethane, 1,1,2,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Tetrachloroethene				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Tetryl				5.00E-04	5.00E-04	5.00E-04	mg/L	27	0
		Thallium	2.60E-03	3.90E-03	3.07E-03	1.25E-03	1.25E-03	1.25E-03	mg/L	34	3
		Toluene				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Toxaphene				3.00E-04	3.00E-04	3.00E-04	mg/L	38	0
		Trichlorobenzene, 1,2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Trichloroethane, 1,1,1-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Trichloroethane, 1,1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Trichloroethene				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Trichlorophenol, 2,4,5-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Trichlorophenol, 2,4,6-				1.00E-03	1.00E-03	1.00E-03	mg/L	33	0
		Trinitrobenzene, 1,3,5-				5.00E-05	5.00E-05	5.00E-05	mg/L	27	0
		Trinitrotoluene, 2,4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	27	2
		Vanadium	1.04E-04	1.31E-03	7.07E-04	5.00E-05	5.00E-05	5.00E-05	mg/L	27	34
		Vinyl acetate	1.01E-02	3.36E-01	6.79E-02	5.00E-03	5.00E-03	5.00E-03	mg/L	31	18
		Vinyl chloride				5.00E-03	5.00E-03	5.00E-03	mg/L	31	0
		Xylenes, total				1.00E-03	1.00E-03	1.00E-03	mg/L	31	0
		Zinc	2.32E-02	4.54E-01	1.19E-01	1.00E-02	1.00E-02	1.00E-02	mg/L	34	23
Sediment	Background Beach	Acenaphthene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Acenaphthylene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Aldrin				1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0

d:\mary\fisher2\surplsou\drftfinl\bchravs\datasum\ecodasum.1st

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 7

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Background Beach	Aluminum				4.77E+02	4.77E+02	mg/kg	1	0
		Amino-2,6-dinitrotoluene, 4-				1.25E-01	1.25E-01	mg/kg	1	0
		Amino-4,6-dinitrotoluene, 2-				1.25E-01	1.25E-01	mg/kg	1	0
		Anthracene				7.00E-02	7.00E-02	mg/kg	1	0
		Antimony				2.50E+00	2.50E+00	mg/kg	1	0
		Arsenic	2.26E+00	2.26E+00	2.26E+00			mg/kg	1	1
		Barium				2.00E+01	2.00E+01	mg/kg	1	0
		Benz(a)anthracene				7.00E-02	7.00E-02	mg/kg	1	0
		Benzo(a)pyrene				7.00E-02	7.00E-02	mg/kg	1	0
		Benzo(b)fluoranthene				7.00E-02	7.00E-02	mg/kg	1	0
		Benzo(g,h,i)perylene				8.00E-02	8.00E-02	mg/kg	1	0
		Benzo(k)fluoranthene				7.00E-02	7.00E-02	mg/kg	1	0
		Benzoic acid				7.00E-01	7.00E-01	mg/kg	1	0
		Benzyl alcohol				7.00E-02	7.00E-02	mg/kg	1	0
		Beryllium				1.00E-01	1.00E-01	mg/kg	1	0
		Bis(2-chloroethoxy) methane				7.00E-02	7.00E-02	mg/kg	1	0
		Bis(2-chloroethyl) ether				7.00E-02	7.00E-02	mg/kg	1	0
		Bis(2-chloroisopropyl) ether				7.00E-02	7.00E-02	mg/kg	1	0
		Bis(2-ethylhexyl) phthalate				7.00E-02	7.00E-02	mg/kg	1	0
		Bromophenyl phenyl ether, 4-				7.00E-02	7.00E-02	mg/kg	1	0
		Butylbenzyl phthalate				7.00E-02	7.00E-02	mg/kg	1	0
		Cadmium	3.48E+04	3.48E+04	3.48E+04			mg/kg	1	1
		Carbazole				7.00E-02	7.00E-02	mg/kg	1	0
		Chlordane, alpha-				1.50E-03	1.50E-03	mg/kg	1	0
		Chlordane, gamma-				1.50E-03	1.50E-03	mg/kg	1	0
		Chlordane, total				1.00E-02	1.00E-02	mg/kg	1	0
		Chloro-3-methylphenol, 4-				7.00E-02	7.00E-02	mg/kg	1	0
		Chloroaniline, 4-				1.50E-01	1.50E-01	mg/kg	1	0
		Chloronaphthalene, 2-				7.00E-02	7.00E-02	mg/kg	1	0
		Chlorophenol, 2-				7.00E-02	7.00E-02	mg/kg	1	0
		Chlorophenyl phenyl ether, 4-				7.00E-02	7.00E-02	mg/kg	1	1
		Chromium, total	2.70E+00	2.70E+00	2.70E+00			mg/kg	1	0
		Chrysene				7.00E-02	7.00E-02	mg/kg	1	0
		Cobalt				1.00E+00	1.00E+00	mg/kg	1	0
		Copper				1.51E+00	1.51E+00	mg/kg	1	0
		Cyanide, total				1.25E-01	1.25E-01	mg/kg	1	1
		DDD, p,p'-						mg/kg	1	0
		DDE, p,p'-						mg/kg	1	0
		DDT, p,p'-						mg/kg	1	0
		Di-n-butyl phthalate				1.50E-03	1.50E-03	mg/kg	1	0
		Di-n-octyl phthalate				7.00E-02	7.00E-02	mg/kg	1	0
		Dibenz(a,h)anthracene				7.00E-02	7.00E-02	mg/kg	1	0
		Dibenzofuran				8.00E-02	8.00E-02	mg/kg	1	0
		Dichlorobenzene, 1,2-				7.00E-02	7.00E-02	mg/kg	1	0
		Dichlorobenzene, 1,3-				7.00E-02	7.00E-02	mg/kg	1	0
		Dichlorobenzene, 1,4-				7.00E-02	7.00E-02	mg/kg	1	0
		Dichlorobenzidine, 3,3'-				3.35E-01	3.35E-01	mg/kg	1	0
		Dichlorophenol, 2,4-				7.00E-02	7.00E-02	mg/kg	1	0
		Dieldrin				1.50E-03	1.50E-03	mg/kg	1	0
		Diethyl phthalate				7.00E-02	7.00E-02	mg/kg	1	0
		Dimethyl phthalate				7.00E-02	7.00E-02	mg/kg	1	0
		Dimethylphenol, 2,4-				1.25E-01	1.25E-01	mg/kg	1	0
		Dinitro-2-methylphenol, 4,6-				7.00E-02	7.00E-02	mg/kg	1	0
		Dinitrobenzene, 1,3-				7.00E-02	7.00E-02	mg/kg	1	0
		Dinitrophenol, 2,4-				7.00E-02	7.00E-02	mg/kg	1	0
		Dinitrotoluene, 2,4-				7.00E-02	7.00E-02	mg/kg	1	0
		Dinitrotoluene, 2,6-				7.00E-02	7.00E-02	mg/kg	1	0
		Endosulfan A				1.50E-03	1.50E-03	mg/kg	1	0
		Endosulfan B				1.50E-03	1.50E-03	mg/kg	1	0

d:\mary\ftsher2\surplou\drftfinl\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
 Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Background Beach	Endosulfan sulfate				1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Endrin				1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Endrin aldehyde				1.10E-02	1.10E-02	1.10E-02	mg/kg	1	0
		Endrin ketone				1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Fluoranthene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Fluorene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		HMX				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Heptachlor				1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Heptachlor epoxide				1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Hexachlorobenzene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Hexachlorobutadiene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Hexachlorocyclohexane, alpha-				1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Hexachlorocyclohexane, beta-				1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Hexachlorocyclohexane, delta-				1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Hexachlorocyclopentadiene				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Hexachlorocyclopentadiene (Lindane)				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Hexachloroethane				8.00E-02	8.00E-02	8.00E-02	mg/kg	1	0
		Indeno(1,2,3-cd)pyrene				2.11E+03	2.11E+03	2.11E+03	mg/kg	1	0
		Iron				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Isophorone							mg/kg	1	1
		Lead	3.72E+00	3.72E+00	3.72E+00				mg/kg	1	1
		Magnesium	1.79E+04	1.79E+04	1.79E+04				mg/kg	1	1
		Manganese	2.26E+02	2.26E+02	2.26E+02				mg/kg	1	1
		Mercury				5.00E-02	5.00E-02	5.00E-02	mg/kg	1	0
		Methoxychlor				1.50E-03	1.50E-03	1.50E-03	mg/kg	1	0
		Methylnaphthalene, 2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Methylphenol, 2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Methylphenol, 4-				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Naphthalene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nickel	3.93E+00	3.93E+00	3.93E+00				mg/kg	1	1
		Nitroaniline, 2-				3.35E-01	3.35E-01	3.35E-01	mg/kg	1	0
		Nitroaniline, 3-				3.35E-01	3.35E-01	3.35E-01	mg/kg	1	0
		Nitroaniline, 4-				3.35E-01	3.35E-01	3.35E-01	mg/kg	1	0
		Nitrobenzene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nitrophenol, 2-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Nitrophenol, 4-				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nitrosodi-N-propylamine, N-				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nitrosodiphenylamine, N-				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Nitrotoluene, 2-				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Nitrotoluene, 3-				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Nitrotoluene, 4-				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Organic carbon, total (TOC)	1.93E+04	1.93E+04	1.93E+04				mg/kg	1	1
		PCB 1016				6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1221				6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1232				6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1242				6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1248				6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1254				6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		PCB 1260				6.50E-03	6.50E-03	6.50E-03	mg/kg	1	0
		Pentachlorophenol				3.35E-01	3.35E-01	3.35E-01	mg/kg	1	0
		Phenanthrene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Phenol				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Potassium				6.90E+01	6.90E+01	6.90E+01	mg/kg	1	0
		Pyrene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		RDH				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Selenium				1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Silver	4.28E+02	4.28E+02	4.28E+02	2.50E-01	2.50E-01	2.50E-01	mg/kg	1	1
		Sodium				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	1
		Tetralin				1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Thallium				1.50E-01	1.50E-01	1.50E-01	mg/kg	1	0
		Toxaphene				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Trichlorobenzene, 1,2,4-				7.00E-02	7.00E-02	7.00E-02	mg/kg	1	0
		Trichlorophenol, 2,4,5-				1.50E-01	1.50E-01	1.50E-01	mg/kg	1	0

d:\mary\ftsher2\surplou\drftfinl\bchra\datasum\ecodasum.lst

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Background Beach	Trichlorophenol, 2,4,6-	.	.	.	1.50E-01	1.50E-01	1.50E-01	mg/kg	1	0
		Trinitrobenzene, 1,3,5-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Trinitrotoluene, 2,4,6-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Vanadium	4.22E+00	4.22E+00	4.22E+00	.	.	.	mg/kg	1	1
		Zinc	1.70E+01	1.70E+01	1.70E+01	.	.	.	mg/kg	1	1
Sediment	Background Ravine	2,4,5-T	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		2,4-D	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		2,4-DB	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Acenaphthene	.	.	.	7.00E-02	3.50E-01	3.50E-01	mg/kg	5	0
		Acenaphthylene	.	.	.	7.00E-02	3.50E-01	3.50E-01	mg/kg	5	0
		Acetone	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Aldrin	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Aluminum	2.58E+03	8.47E+03	5.30E+03	.	.	.	mg/kg	5	5
		Amino-2,6-dinitrotoluene, 4-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	5	0
		Amino-4,6-dinitrotoluene, 2-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	5	0
		Anthracene	.	.	.	7.00E-02	3.50E-01	3.50E-01	mg/kg	5	0
		Antimony	.	.	.	2.50E+00	2.50E+00	2.50E+00	mg/kg	5	0
		Arsenic	7.00E+00	1.40E+01	1.02E+01	.	.	.	mg/kg	5	5
		Barium	3.96E+01	5.87E+01	4.91E+01	1.99E+01	1.99E+01	1.99E+01	mg/kg	5	2
		Benz(a)anthracene	2.00E+00	2.00E+00	2.00E+00	7.00E-02	3.50E-01	3.50E-01	mg/kg	5	1
		Benzene	2.00E+00	2.00E+00	2.00E+00	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Benzo(a)pyrene	2.00E+00	2.00E+00	2.00E+00	7.00E-02	3.50E-01	3.50E-01	mg/kg	5	1
		Benzo(b)fluoranthene	2.00E+00	2.00E+00	2.00E+00	7.00E-02	3.50E-01	3.50E-01	mg/kg	5	1
		Benzo(ghi)perylene	1.00E+00	1.00E+00	1.00E+00	8.00E-02	4.00E-01	4.00E-01	mg/kg	5	1
		Benzo(k)fluoranthene	1.00E+00	1.00E+00	1.00E+00	7.00E-02	3.50E-01	3.50E-01	mg/kg	5	1
		Benzoic acid	.	.	.	7.00E-01	3.50E+00	1.82E+00	mg/kg	5	0
		Benzyl alcohol	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Beryllium	7.56E-01	7.56E-01	7.56E-01	2.50E-01	2.50E-01	2.50E-01	mg/kg	5	1
		Bis(2-chloroethoxy) methane	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Bis(2-chloroethyl) ether	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Bis(2-chloroisopropyl) ether	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Bis(2-ethylhexyl) phthalate	1.90E-01	2.00E+00	7.13E-01	3.50E-01	3.50E-01	3.50E-01	mg/kg	5	4
		Bromodichloromethane	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Bromoform	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Bromomethane	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Bromophenyl phenyl ether, 4-	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Butylbenzyl phthalate	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Cadmium	3.78E+04	7.36E+04	5.73E+04	2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Calcium	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	5
		Carbazole	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Carbon disulfide	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Carbon tetrachloride	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chlordane, alpha-	6.55E-03	6.55E-03	6.55E-03	1.50E-03	1.50E-03	1.50E-03	mg/kg	5	1
		Chlordane, gamma-	5.95E-03	6.55E-03	6.25E-03	1.50E-03	1.50E-03	1.50E-03	mg/kg	5	2
		Chlordane, total	2.49E-02	5.24E-02	3.87E-02	1.00E-02	1.00E-02	1.00E-02	mg/kg	5	2
		Chloro-3-methylphenol, 4-	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Chloroaniline, 4-	.	.	.	1.50E-01	1.00E+00	4.90E-01	mg/kg	5	0
		Chlorobenzene	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chloroethane	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chloroethylvinyl ether, 2-	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chloroform	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chloromethane	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Chloronaphthalene, 2-	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Chlorophenol, 2-	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Chlorophenyl phenyl ether, 4-	.	.	.	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Chromium, total	6.42E+00	1.30E+01	9.46E+00	.	.	.	mg/kg	5	5
		Chrysene	2.00E+00	2.00E+00	2.00E+00	7.00E-02	3.50E-01	1.40E-01	mg/kg	5	1
		Cobalt	4.92E+00	1.02E+01	7.74E+00	.	.	.	mg/kg	5	5
		Copper	9.26E+00	1.83E+01	1.49E+01	.	.	.	mg/kg	5	5

d:\mary\fisher2\surplsum\dirftfinl\bchraums\datasum\scodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 10

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Background Ravine	Cyanide, total				1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		DDD, P,p'-	1.52E-02	2.60E-01	1.04E-01				mg/kg	5	5
		DDE, P,p'-	3.63E-02	6.52E-02	2.97E-02				mg/kg	5	5
		DDT, P,p'-	9.03E-03	5.41E-02	3.67E-02				mg/kg	5	5
		Dalapon				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Di-n-butyl phthalate				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Di-n-octyl phthalate				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dibenz (ah) anthracene				8.00E-02	4.00E-01	2.08E-01	mg/kg	5	0
		Dibenzofuran				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dibromochloromethane				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dicamba				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichlorobenzene, 1,2-				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dichlorobenzene, 1,3-				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dichlorobenzene, 1,4-				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dichlorobenzidine, 3,3'-				3.35E-01	1.50E+00	8.01E-01	mg/kg	5	0
		Dichloroethane, 1,1-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloroethene, 1,2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloroethene, 1,1-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloroethene, 1,2-, total				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichlorophenol, 2,4-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloropropane, 1,2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloropropene, 1,3-, cis-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichloropropene, 1,3-, trans-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dieldrin				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Diethyl phthalate				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dimethyl phthalate				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Dinitro-2-methylphenol, 4,6-				7.00E-01	3.50E+00	1.82E+00	mg/kg	5	0
		Dinitrobenzene, 1,3-				1.25E-01	1.25E-01	1.25E-01	mg/kg	5	0
		Dinitrophenol, 2,4-				7.00E-01	3.50E+00	1.82E+00	mg/kg	5	0
		Dinitrotoluene, 2,6-				7.00E-02	1.00E-01	8.20E-02	mg/kg	5	0
		Dinitrotoluene, 3,4-				7.00E-02	1.00E-01	8.20E-02	mg/kg	5	0
		Dinoseb	4.20E+00	4.46E+00	4.32E+00				mg/kg	5	5
		Endosulfan A				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Endosulfan B				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Endosulfan sulfate				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Endrin				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Endrin aldehyde				1.10E-02	1.10E-02	1.10E-02	mg/kg	5	0
		Endrin ketone				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Ethylbenzene				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Fluoranthene				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	2
		Fluorene	2.00E+00	5.00E+00	3.50E+00				mg/kg	5	0
		HMX				7.00E-01	3.50E-01	2.50E-01	mg/kg	5	0
		Heptachlor				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Heptachlor epoxide	8.68E-03	8.68E-03	8.68E-03	1.50E-03	1.50E-03	1.50E-03	mg/kg	5	1
		Hexachlorobenzene				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Hexachlorobutadiene				7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Hexachlorocyclohexane, alpha-				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Hexachlorocyclohexane, beta-				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Hexachlorocyclohexane, delta-				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Hexachlorocyclohexane, gamma-				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Hexachlorocyclopentadiene				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Hexachloroethane				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	1
		Indeno (1,2,3-cd)pyrene	7.60E-03	7.60E-03	7.60E-03	1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Iron	1.00E+00	1.00E+00	1.00E+00	7.00E-02	3.50E-01	1.82E-01	mg/kg	5	0
		Isononene	1.01E+04	1.84E+04	1.43E+04				mg/kg	5	5
		Lead	8.03E+00	4.30E+01	1.86E+01				mg/kg	5	5
		MCPA				1.00E-01	1.00E-01	1.00E-01	mg/kg	5	0

d:\mary\ftsher2\surplou\drftfin\hchravs\datasum\ecodasum.lst



Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 11

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Background Ravine	MCPP				1.00E-01	1.00E-01	1.00E-01	mg/kg	5	0
		Magnesium	2.48E+04	4.48E+04	3.46E+04				mg/kg	5	5
		Manganese	4.69E+02	8.87E+02	6.06E+02				mg/kg	5	5
		Mercury				5.00E-02	5.00E-02	5.00E-02	mg/kg	5	0
		Methoxychlor				1.50E-03	1.50E-03	1.50E-03	mg/kg	5	0
		Methyl ethyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Methyl isobutyl ketone				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Methylene chloride				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Methylnaphthalene, 2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Methylphenol, 2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Methylphenol, 4-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Naphthalene				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Nickel	9.85E+00	2.09E+01	1.63E+01				mg/kg	5	5
		Nitroaniline, 2-				3.35E-01	3.35E-01	3.35E-01	mg/kg	5	0
		Nitroaniline, 3-				3.35E-01	3.35E-01	3.35E-01	mg/kg	5	0
		Nitroaniline, 4-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Nitrobenzene				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Nitrophenol, 2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Nitrophenol, 4-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Nitrosodi-N-propylamine, N-				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Nitrosodiphenylamine, N-				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Nitrotoluene, 2-				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Nitrotoluene, 3-				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Nitrotoluene, 4-				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	1
		Organic carbon, total (TOC)	2.45E+04	2.45E+04	2.45E+04				mg/kg	5	0
		PCB 1016				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1221				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1232				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1242				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1248				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1254				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		PCB 1260				6.50E-03	6.50E-03	6.50E-03	mg/kg	5	0
		Pentachlorophenol				3.35E-01	3.35E-01	3.35E-01	mg/kg	5	0
		Petroleum hydrocarbons, total (TPH)	5.39E+01	7.82E+01	6.21E+01	1.38E+01	1.38E+01	1.38E+01	mg/kg	5	3
		Phenanthrene	2.00E+00	4.00E+00	3.00E+00	7.00E-02	7.00E-02	7.00E-02	mg/kg	5	2
		Phenol				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Potassium	8.39E+02	1.83E+03	1.26E+03	3.29E+02	3.29E+02	3.29E+02	mg/kg	5	4
		Pyrene	2.00E+00	4.00E+00	3.00E+00	7.00E-02	7.00E-02	7.00E-02	mg/kg	5	2
		RDX				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Selenium				1.25E-01	1.25E-01	1.25E-01	mg/kg	5	0
		Silver				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Silvex (2,4,5-TP)				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Sodium	4.10E+02	5.08E+02	4.66E+02				mg/kg	5	5
		Styrene				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Tetrachloroethane, 1,1,2,2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Tetrachloroethene				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Tetryl				2.50E-01	2.50E-01	2.50E-01	mg/kg	5	0
		Thallium	3.76E-01	1.39E+00	8.07E-01				mg/kg	5	5
		Toluene				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Toxaphene				1.50E-01	1.50E-01	1.50E-01	mg/kg	5	0
		Trichlorobenzene, 1,2,4-				7.00E-02	7.00E-02	7.00E-02	mg/kg	5	0
		Trichloroethane, 1,1,1-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Trichloroethane, 1,1,2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Trichloroethene				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Trichlorophenol, 2,4,5-				1.50E-01	1.50E-01	1.50E-01	mg/kg	5	0
		Trichlorophenol, 2,4,6-				1.50E-01	1.50E-01	1.50E-01	mg/kg	5	0
		Trinitrotoluene, 2,4,6-				1.25E-01	1.25E-01	1.25E-01	mg/kg	5	0
		Vanadium	1.07E+01	2.35E+01	1.80E+01				mg/kg	5	5
		Vinyl acetate				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Vinyl chloride				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Xylenes, total				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Zinc	3.05E+01	5.35E+01	3.94E+01				mg/kg	5	5

d:\mary\fisher2\surplusou\drftfinl\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 12

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Beach	2,4-D	2.39E-01	2.39E-01	2.39E-01	8.85E-03	8.85E-03	8.85E-03	mg/kg	1	0
		Acenaphthene				1.80E-02	7.00E-02	3.06E-02	mg/kg	9	1
		Acenaphthylene				1.65E-02	7.00E-02	3.36E-02	mg/kg	9	0
		Acetone				8.50E-03	5.00E-02	8.50E-03	mg/kg	6	0
		Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/kg	6	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/kg	6	0
		Aldrin				1.50E-03	1.65E-01	1.19E-01	mg/kg	7	0
		Aluminum	1.71E+03	6.40E+03	3.33E+03	6.00E+02	1.30E+03	8.13E+02	mg/kg	9	4
		Amino-2,6-dinitrotoluene, 4-				1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Amino-4,6-dinitrotoluene, 2-				1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Anthracene				3.35E-03	7.00E-02	1.95E-02	mg/kg	9	0
		Antimony	6.90E+00	1.78E+01	1.24E+01	1.90E+00	2.50E+00	2.07E+00	mg/kg	9	2
		Arsenic	3.50E+00	1.31E+01	5.81E+00				mg/kg	9	9
		Barium	2.05E-03	6.11E-03	4.08E-03	1.48E+01	2.00E+01	1.65E+01	mg/kg	9	0
		Benz(a)anthracene				7.00E-02	8.50E-02	8.29E-02	mg/kg	9	2
		Benzene				7.50E-04	7.50E-04	7.50E-04	mg/kg	6	0
		Benzidine				4.25E-01	4.25E-01	4.25E-01	mg/kg	6	0
		Benzo(a)pyrene	2.95E-03	7.21E-03	5.08E-03	7.00E-02	1.25E-01	1.17E-01	mg/kg	9	2
		Benzo(b)fluoranthene	4.51E-03	8.01E-03	6.26E-03	7.00E-02	1.05E-01	1.00E-01	mg/kg	9	2
		Benzo(ghi)perylene	9.31E-03	9.31E-03	9.31E-03	3.35E-03	1.25E-01	1.04E-01	mg/kg	9	1
		Benzo(k)fluoranthene	2.13E-03	4.14E-03	3.14E-03	3.30E-02	7.00E-02	3.83E-02	mg/kg	9	2
		Benzoic acid				7.00E-01	3.05E+00	2.71E+00	mg/kg	7	0
		Benzyl alcohol				7.00E-02	9.50E-02	9.14E-02	mg/kg	7	0
		Beryllium				1.00E-01	9.30E-01	6.53E-01	mg/kg	9	0
		Bis(2-chloroethoxy) methane				2.95E-02	7.00E-02	3.53E-02	mg/kg	7	0
		Bis(2-chloroethyl) ether				1.65E-02	7.00E-02	2.41E-02	mg/kg	7	0
		Bis(2-chloroisopropyl) ether				7.00E-02	1.00E-01	9.57E-02	mg/kg	7	0
		Bis(2-ethylhexyl) phthalate				7.00E-02	3.10E-01	2.76E-01	mg/kg	7	0
		Bromodichloromethane				1.45E-03	1.45E-03	1.45E-03	mg/kg	6	0
		Bromoform				3.45E-03	3.45E-03	3.45E-03	mg/kg	6	0
		Bromomethane				2.85E-03	2.85E-03	2.85E-03	mg/kg	6	0
		Bromophenyl phenyl ether, 4-				1.65E-02	7.00E-02	2.41E-02	mg/kg	7	0
		Butylbenzyl phthalate				7.00E-02	8.50E-02	8.29E-02	mg/kg	7	0
		Cadmium	3.76E+04	1.20E+05	7.67E+04	2.50E-01	1.53E+00	1.10E+00	mg/kg	9	0
		Calcium				7.00E-02	7.00E-02	7.00E-02	mg/kg	9	9
		Carbazole				2.20E-03	2.20E-03	2.20E-03	mg/kg	1	0
		Carbon disulfide				3.50E-03	3.50E-03	3.50E-03	mg/kg	6	0
		Carbon tetrachloride				1.50E-03	1.50E-03	1.50E-03	mg/kg	7	0
		Chlordane, alpha-				1.50E-03	1.50E-03	1.50E-03	mg/kg	7	0
		Chlordane, gamma-				1.50E-03	1.50E-03	1.50E-03	mg/kg	7	0
		Chlordane, total	1.18E-01	1.18E-01	1.18E-01	1.00E-02	1.00E-02	1.00E-02	mg/kg	2	1
		Chloro-3-methylphenol, 4-				7.75E-02	7.00E-02	5.07E-02	mg/kg	7	0
		Chloroaniline, 4-				1.50E-01	4.05E-01	3.69E-01	mg/kg	7	0
		Chlorobenzene				4.30E-04	4.30E-04	4.30E-04	mg/kg	6	0
		Chloroethane				6.00E-03	6.00E-03	6.00E-03	mg/kg	6	0
		Chloroethylvinyl ether, 2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	6	0
		Chloromethane				4.35E-04	4.35E-04	4.35E-04	mg/kg	6	0
		Chloronaphthalene, 2-				4.40E-03	4.40E-03	4.40E-03	mg/kg	6	0
		Chlorophenol, 2-				1.80E-02	7.00E-02	2.54E-02	mg/kg	7	0
		Chlorophenyl phenyl ether, 4-				3.00E-02	7.00E-02	3.57E-02	mg/kg	7	0
		Chromium, total	4.22E+00	4.68E+00	4.41E+00	1.65E-02	2.41E-02	2.41E-02	mg/kg	7	0
		Chrysene	2.02E+00	3.51E+00	2.55E+00	6.35E+00	6.35E+00	6.35E+00	mg/kg	9	3
		Cobalt	5.55E+00	8.06E+00	6.81E+00	3.35E-03	7.50E+00	4.85E-02	mg/kg	9	0
		Copper				2.93E+01	2.93E+01	7.50E+00	mg/kg	9	2
		Cyanide, total				1.25E-01	4.60E-01	2.54E+01	mg/kg	9	2
		DDD, P,p'-	9.66E-03	4.30E-01	2.20E-01	1.35E-01	1.35E-01	1.35E-01	mg/kg	7	2
		DDG, P,p'-	3.50E-02	3.50E-02	3.50E-02	1.50E-03	1.55E-01	1.29E-01	mg/kg	7	1
		DDT, P,p'-	9.80E-02	9.80E-02	9.80E-02	1.50E-03	1.55E-01	1.29E-01	mg/kg	7	1
		Di-n-butyl phthalate				3.05E-02	7.00E-02	3.61E-02	mg/kg	7	0
		Di-n-octyl phthalate				7.00E-02	9.50E-02	9.14E-02	mg/kg	7	0
		Dibenz(ah)anthracene				1.65E-03	1.65E-03	1.65E-03	mg/kg	9	0
		Dibenzofuran				1.75E-02	7.00E-02	2.50E-02	mg/kg	7	0

d:\mary\ftsher2\surplsou\drftfin\bcbravs\datasum\ecodasum.lst

d:\mary\ftsher2\surplsou\drftfinl\bchravs\datasumm\ecodasum.1st

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 14

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Beach	Nitroaniline, 2-				3.10E-02	3.35E-01	7.44E-02	mg/kg	7	0
		Nitroaniline, 3-				2.25E-01	3.35E-01	2.41E-01	mg/kg	7	0
		Nitroaniline, 4-				2.05E-01	3.35E-01	2.24E-01	mg/kg	7	0
		Nitrobenzene				2.25E-02	7.00E-02	2.93E-02	mg/kg	7	0
		Nitroglycerine				2.00E+00	2.00E+00	2.00E+00	mg/kg	5	0
		Nitrophenol, 2-				7.00E-02	7.00E-02	7.00E-02	mg/kg	7	0
		Nitrophenol, 4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	7	0
		Nitrosodi-N-propylamine, N-				7.00E-02	1.00E-01	9.57E-02	mg/kg	7	0
		Nitrosodimethylamine, N-				7.00E-02	7.00E-02	7.00E-02	mg/kg	6	0
		Nitrosodiphenylamine, N-				7.00E-02	9.14E-02	9.14E-02	mg/kg	7	0
		Nitrotoluene, 2-				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Nitrotoluene, 3-				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Nitrotoluene, 4-				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Organic carbon, total (TOC)	1.77E+04	1.77E+04	1.77E+04				mg/kg	1	1
		PCB 1016				6.50E-03	7.00E-01	5.06E-01	mg/kg	7	0
		PCB 1221				6.50E-03	7.00E-01	5.07E-01	mg/kg	7	0
		PCB 1232				6.50E-03	7.00E-01	5.07E-01	mg/kg	7	0
		PCB 1242				6.50E-03	7.00E-01	5.07E-01	mg/kg	7	0
		PCB 1248				6.50E-03	1.00E+00	7.21E-01	mg/kg	7	0
		PCB 1254				6.50E-03	1.15E+00	8.28E-01	mg/kg	7	0
		PCB 1260				6.50E-03	1.30E+00	9.35E-01	mg/kg	7	0
		PETN				2.00E+00	2.00E+00	2.00E+00	mg/kg	5	0
		Pentachlorophenol				3.35E-01	6.50E-01	6.05E-01	mg/kg	7	0
		Phenanthrene	5.20E-02	5.30E-02	5.25E-02	1.65E-02	7.00E-02	2.41E-02	mg/kg	9	2
		Phenol				5.50E-02	7.00E-02	5.71E-02	mg/kg	7	0
		Potassium	2.79E+02	2.01E+03	9.44E+02	7.65E+01	1.61E+02	1.21E+02	mg/kg	9	4
		Pyrene	1.36E-02	2.76E-02	2.06E-02	1.65E-02	7.00E-02	2.41E-02	mg/kg	9	2
		RDX				2.50E-01	2.94E-01	2.86E-01	mg/kg	6	0
		Selenium				1.25E-01	1.25E-01	1.25E-01	mg/kg	9	0
		Silver				2.50E-01	1.25E+00	9.17E-01	mg/kg	9	0
		Silvex (2,4,5-TP)				4.25E-03	4.25E-03	4.25E-03	mg/kg	1	0
		Sodium	1.25E+02	5.13E+02	3.84E+02				mg/kg	9	9
		Styrene				1.30E-03	1.30E-03	1.30E-03	mg/kg	6	0
		Tetrachloroethane, 1,1,2,2-				1.20E-03	1.20E-03	1.20E-03	mg/kg	6	0
		Tetrachloroethene				4.05E-04	4.05E-04	4.05E-04	mg/kg	6	0
		Tetryl				2.50E-01	3.46E-01	3.46E-01	mg/kg	6	0
		Thallium				1.25E-01	1.25E-01	1.25E-01	mg/kg	3	0
		Toluene				3.90E-04	3.90E-04	3.90E-04	mg/kg	6	0
		Toxaphene				1.50E-01	1.30E+00	9.82E-01	mg/kg	7	0
		Trichlorobenzene, 1,2,4-				2.00E-02	7.00E-02	2.71E-02	mg/kg	7	0
		Trichloroethane, 1,1,1-				2.20E-03	2.20E-03	2.20E-03	mg/kg	6	0
		Trichloroethane, 1,1,2-				2.70E-03	2.70E-03	2.70E-03	mg/kg	6	0
		Trichloroethene				1.40E-03	1.40E-03	1.40E-03	mg/kg	6	0
		Trichlorofluoromethane	6.80E-03	1.00E-02	8.00E-03	2.95E-03	2.95E-03	2.95E-03	mg/kg	6	3
		Trichlorophenol, 2,4,5-				5.00E-02	1.50E-01	6.43E-02	mg/kg	7	0
		Trichlorophenol, 2,4,6-				8.50E-02	1.50E-01	9.43E-02	mg/kg	7	0
		Trinitrobenzene, 1,3,5-				1.25E-01	2.44E-01	2.24E-01	mg/kg	6	0
		Trinitrotoluene, 2,4,6-				1.25E-01	2.28E-01	2.11E-01	mg/kg	6	0
		Vanadium	5.98E+00	5.90E+01	2.46E+01	6.50E+00	6.50E+00	6.50E+00	mg/kg	9	6
		Vinyl acetate				1.60E-03	1.60E-03	1.60E-03	mg/kg	6	0
		Vinyl chloride				3.10E-03	3.10E-03	3.10E-03	mg/kg	6	0
		Xylenes, total				7.50E-04	7.50E-04	7.50E-04	mg/kg	6	0
		Zinc	2.18E+01	1.40E+02	5.63E+01	1.51E+01	1.51E+01	1.51E+01	mg/kg	9	6
Sediment	Hutchinson Ravine	2,4,5-T	2.72E-02	2.72E-02	2.72E-02	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	1
		2,4-D				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Acenaphthene	2.14E-01	2.45E+00	1.13E+00	5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Acenaphthylene	1.37E-01	1.73E+00	9.18E-01	1.80E-02	1.50E-01	8.29E-02	mg/kg	11	6
		Acetone				1.65E-02	3.50E-01	1.22E-01	mg/kg	11	3
						5.00E-03	8.50E-03	5.58E-03	mg/kg	6	0

d:\mary\ftsher2\surp1sou\drftfinl\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 15

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Hutchinson Ravine	Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/kg	1	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/kg	1	0
		Aldrin	4.33E-03	2.53E-02	1.55E-02	1.50E-03	1.65E-01	2.19E-02	mg/kg	11	3
		Aluminum	3.51E+03	9.10E+03	5.57E+03	1.02E+03	2.83E+03	1.95E+03	mg/kg	11	7
		Amino-2,6-dinitrotoluene, 4-				1.25E-01	1.25E-01	1.25E-01	mg/kg	7	0
		Amino-4,6-dinitrotoluene, 2-				1.25E-01	1.25E-01	1.25E-01	mg/kg	7	0
		Anthracene	3.30E-01	7.00E+00	2.96E+00	1.65E-02	1.50E-01	8.66E-02	mg/kg	11	7
		Antimony	7.65E+00	7.88E+00	7.77E+00	1.90E+00	2.50E+00	2.43E+00	mg/kg	11	2
		Arsenic	4.01E+00	7.35E+00	5.70E+00				mg/kg	11	11
		Barium	3.91E+01	6.45E+01	5.50E+01				mg/kg	11	4
		Benz(a)anthracene	7.10E-02	1.00E+01	2.18E+00	1.48E+01	2.00E+01	1.93E+01	mg/kg	11	8
		Benzene				7.50E-04	5.00E-03	1.15E-01	mg/kg	11	0
		Benzidine				4.25E-01	4.25E-01	4.25E-01	mg/kg	1	0
		Benzo(a)pyrene	7.10E-02	8.00E+00	1.79E+00	1.05E-01	1.50E-01	1.28E-01	mg/kg	11	8
		Benzo(b)fluoranthene	8.90E-02	8.00E+00	1.80E+00	1.05E-01	1.50E-01	1.22E-01	mg/kg	11	8
		Benzo(ghi)perylene	1.20E-01	4.00E+00	1.42E+00	6.50E-02	1.50E-01	1.09E-01	mg/kg	11	5
		Benzo(k)fluoranthene	2.70E-02	5.00E+00	1.08E+00	1.10E-01	1.50E-01	1.30E-01	mg/kg	11	9
		Benzoic acid				7.00E-01	3.50E+00	1.51E+00	mg/kg	11	0
		Benzyl alcohol				7.00E-02	3.50E-01	1.32E-01	mg/kg	11	0
		Beryllium	2.97E-01	8.37E-01	4.82E-01	1.00E-01	9.30E-01	5.15E-01	mg/kg	11	9
		Bis(2-chloroethoxy) methane				2.95E-02	3.50E-01	1.26E-01	mg/kg	11	0
		Bis(2-chloroethyl) ether				1.65E-02	3.50E-01	1.25E-01	mg/kg	11	0
		Bis(2-chloroisopropyl) ether				7.00E-02	3.50E-01	1.33E-01	mg/kg	11	0
		Bis(2-ethylhexyl) phthalate	2.15E-01	2.15E-01	2.15E-01	7.00E-02	3.50E-01	1.60E-01	mg/kg	11	1
		Bromodichloromethane				1.45E-03	5.00E-03	4.41E-03	mg/kg	6	0
		Bromoform				3.45E-03	5.00E-03	4.74E-03	mg/kg	6	0
		Bromomethane				2.85E-03	5.00E-03	4.64E-03	mg/kg	6	0
		Bromophenyl phenyl ether, 4-				1.65E-02	3.50E-01	1.25E-01	mg/kg	11	0
		Butylbenzyl phthalate				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Cadmium	5.37E-01	5.37E-01	5.37E-01	2.50E-01	1.53E+00	3.78E-01	mg/kg	11	1
		Calcium	2.45E+04	1.20E+05	5.81E+04				mg/kg	11	11
		Carbazole	1.00E+00	2.00E+00	1.50E+00	7.00E-02	2.50E-01	1.08E-01	mg/kg	10	2
		Carbon disulfide				2.20E-03	5.00E-03	4.53E-03	mg/kg	6	0
		Carbon tetrachloride				3.50E-03	5.00E-03	4.75E-03	mg/kg	6	0
		Chlordane, alpha-	8.60E-02	8.60E-02	8.60E-02	1.50E-03	1.65E-01	1.79E-02	mg/kg	11	1
		Chlordane, gamma-	3.04E-03	9.44E-02	4.87E-02	1.50E-03	1.65E-01	1.99E-02	mg/kg	11	2
		Chlordane, total	1.83E-02	9.30E-01	2.35E-01	1.00E-02	1.50E-02	1.10E-02	mg/kg	10	5
		Chloro-3-methylphenol, 4-				4.75E-02	3.50E-01	1.28E-01	mg/kg	11	0
		Chloroaniline, 4-				1.50E-01	1.00E+00	3.30E-01	mg/kg	11	0
		Chlorobenzene				4.30E-04	5.00E-03	4.24E-03	mg/kg	6	0
		Chloroethane				5.00E-03	6.00E-03	5.17E-03	mg/kg	6	0
		Chloroethylvinyl ether, 2-				5.00E-03	5.00E-03	5.00E-03	mg/kg	6	0
		Chloroform				4.40E-03	5.00E-03	4.90E-03	mg/kg	6	0
		Chloromethane				1.80E-02	3.50E-01	1.25E-01	mg/kg	11	0
		Chloronaphthalene, 2-				3.00E-02	3.50E-01	1.26E-01	mg/kg	11	0
		Chlorophenol, 2-				1.65E-02	3.50E-01	1.25E-01	mg/kg	11	0
		Chlorophenyl phenyl ether, 4-				3.37E+00	6.35E+00	4.78E+00	mg/kg	11	8
		Chromium, total	4.22E+00	1.50E+01	9.00E+00	6.50E-02	1.50E-01	1.08E-01	mg/kg	11	8
		Chrysene	2.50E-01	1.00E+01	2.50E+00	7.50E+00	7.50E+00	7.50E+00	mg/kg	11	10
		Cobalt	3.29E+00	1.23E+01	7.91E+00	2.93E+01	2.93E+01	2.93E+01	mg/kg	11	10
		Copper	7.83E+00	2.65E+01	1.83E+01	1.25E-01	4.60E-01	1.59E-01	mg/kg	11	1
		Cyanide, total	7.83E-01	7.83E-01	7.83E-01				mg/kg	11	11
		DDD, P,p'-	1.07E-02	1.00E-01	1.36E+00				mg/kg	11	11
		DDG, P,p'-	7.31E-03	1.81E-01	1.81E-01	1.55E-01	1.55E-01	1.55E-01	mg/kg	11	10
		DDT, P,p'-	5.28E-03	9.30E-01	3.33E-01	1.55E-01	1.55E-01	1.55E-01	mg/kg	11	10
		Dalapon				3.05E-02	3.50E-01	5.00E-03	mg/kg	5	0
		Di-n-butyl phthalate				7.00E-02	3.50E-01	1.26E-01	mg/kg	11	0
		Di-n-octyl phthalate				7.00E-02	3.50E-01	1.32E-01	mg/kg	11	0
		Dibenz(ah)anthracene	2.70E-01	6.00E-01	4.35E-01	1.65E-02	4.00E-01	1.11E-01	mg/kg	11	2
		Dibenzofuran	6.00E-01	2.00E+00	1.30E+00	1.75E-02	2.50E-01	9.75E-02	mg/kg	11	2

d:\mary\fisher2\surplsou\drftfin\bhcrav\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 16

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Hutchinson Ravine	Dibromochloromethane				1.55E-03	5.00E-03	4.43E-03	mg/kg	6	0
		Dicamba				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Dichlorobenzene, 1,2-				5.50E-02	3.50E-01	1.29E-01	mg/kg	11	0
		Dichlorobenzene, 1,3-				6.50E-02	3.50E-01	1.30E-01	mg/kg	11	0
		Dichlorobenzene, 1,4-				4.90E-02	3.50E-01	1.28E-01	mg/kg	11	0
		Dichlorobenzenes, total				5.00E-02	5.00E-02	5.00E-02	mg/kg	1	0
		Dichlorobenzidine, 3,3'-				3.35E-01	3.15E+00	7.95E-01	mg/kg	11	0
		Dichloroethane, 1,1-				1.15E-03	5.00E-03	4.36E-03	mg/kg	6	0
		Dichloroethane, 1,2-				8.50E-04	5.00E-03	4.31E-03	mg/kg	6	0
		Dichloroethene, 1,1-				1.95E-03	5.00E-03	4.49E-03	mg/kg	6	0
		Dichloroethenes, 1,2-, total				1.50E-03	5.00E-03	4.42E-03	mg/kg	6	0
		Dichloropropane, 1,2-				7.00E-02	3.50E-01	1.32E-01	mg/kg	11	0
		Dichloropropene, 1,3-, cis-				1.45E-03	5.00E-03	4.41E-03	mg/kg	6	0
		Dichloropropene, 1,3-, trans-				1.60E-03	5.00E-03	4.43E-03	mg/kg	6	0
		Dichloroprop				5.00E-03	5.00E-03	4.40E-03	mg/kg	6	0
		Dieldrin				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Diethyl phthalate				1.50E-03	1.55E-01	1.55E-02	mg/kg	11	0
		Dimethyl phthalate				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Dimethylphenol, 2,4-				7.00E-02	3.50E-01	1.55E-01	mg/kg	11	0
		Dinitro-2-methylphenol, 4,6-				2.75E-01	3.50E+00	1.26E+00	mg/kg	11	0
		Dinitrobenzene, 1,3-				1.25E-01	1.25E-01	1.25E-01	mg/kg	7	0
		Dinitrophenol, 2,4-				6.00E-01	3.50E+00	1.29E+00	mg/kg	11	0
		Dinitrotoluene, 2,4-				7.00E-02	1.00E-01	8.36E-02	mg/kg	11	0
		Dinitrotoluene, 2,6-				4.25E-02	1.00E-01	8.11E-02	mg/kg	11	0
		Dinoseb				5.00E-03	5.00E-03	5.00E-03	mg/kg	5	0
		Diphenylhydrazine, 1,2-				7.00E-02	3.50E-01	1.35E-01	mg/kg	11	0
		Endosulfan A				7.00E-02	3.50E-01	1.31E-01	mg/kg	11	0
		Endosulfan B				7.00E-02	3.50E-01	1.55E-01	mg/kg	11	0
		Endosulfan sulfate				2.75E-01	3.50E+00	1.26E+00	mg/kg	11	0
		Endrin	1.18E-02	2.03E-02	1.61E-02	1.50E-03	3.10E-01	2.95E-02	mg/kg	11	0
		Endrin aldehyde				1.50E-03	3.10E-01	2.95E-02	mg/kg	11	0
		Endrin ketone				1.10E-02	2.55E-01	2.43E-02	mg/kg	11	2
		Ethylbenzene				1.50E-03	2.65E-01	3.41E-02	mg/kg	11	0
		Fluoranthene				1.50E-03	2.65E-01	2.55E-02	mg/kg	11	0
		Fluorene				8.50E-04	5.00E-03	4.31E-03	mg/kg	6	0
		HMX				1.10E-01	1.50E-01	1.30E-01	mg/kg	11	9
		Heptachlor				1.50E-02	1.50E-01	1.30E-01	mg/kg	11	6
		Heptachlor epoxide				1.65E-02	1.50E-01	7.26E-02	mg/kg	11	6
		Hexachlorobenzene				2.50E-01	2.50E-01	2.50E-01	mg/kg	7	0
		Hexachlorobutadiene				1.50E-03	6.50E-02	7.27E-03	mg/kg	11	0
		Hexachlorocyclohexane, alpha-				1.50E-03	1.50E-01	1.64E-02	mg/kg	11	0
		Hexachlorocyclohexane, beta-				1.50E-03	1.35E-01	1.36E-02	mg/kg	11	0
		Hexachlorocyclohexane, delta-				1.50E-03	1.35E-01	1.36E-02	mg/kg	11	0
		Hexachlorocyclopentadiene				1.50E-03	1.35E-01	1.36E-02	mg/kg	11	0
		(Lindane)	5.14E-03	6.28E-03	5.71E-03	1.50E-03	1.35E-01	1.63E-02	mg/kg	11	2
		Hexachloroethane				5.00E-01	3.10E+00	1.15E+00	mg/kg	11	0
		Indeno(1,2,3-cd)pyrene				7.00E-02	3.50E-01	1.30E-01	mg/kg	11	0
		Iron	9.40E-02	4.00E+00	1.14E+00	1.65E-02	1.50E-01	1.01E-01	mg/kg	11	6
		Isophorone	7.57E+03	2.22E+04	1.65E+04	1.65E-02	1.50E-01	1.01E-01	mg/kg	11	11
		Lead				1.65E-02	3.50E-01	1.25E-01	mg/kg	11	0
		MCPA	1.20E+01	5.48E+01	3.14E+01	1.00E-01	1.00E-01	1.00E-01	mg/kg	11	11
		MCPP				1.00E-01	1.00E-01	1.00E-01	mg/kg	5	0
		Magnesium	1.49E+04	5.80E+04	3.06E+04	2.50E-02	5.00E-02	4.72E-02	mg/kg	11	11
		Manganese	2.96E+02	1.63E+03	8.47E+02	1.50E-03	1.65E-01	1.64E-02	mg/kg	11	2
		Mercury	1.02E-01	2.20E-01	1.61E-01	5.00E-03	3.50E-02	1.00E-02	mg/kg	11	0
		Methoxychlor				5.00E-03	1.35E-02	6.42E-03	mg/kg	6	0
		Methyl ethyl ketone				5.00E-03	1.35E-02	6.42E-03	mg/kg	6	0
		Methyl isobutyl ketone				5.00E-03	1.35E-02	6.42E-03	mg/kg	6	0
		Methyl n-butyl ketone				5.00E-03	1.35E-02	6.42E-03	mg/kg	6	0
		Methylene chloride				5.00E-03	1.35E-02	6.42E-03	mg/kg	6	0
		Methylenethiolide, 1-	3.98E-01	2.89E+00	1.61E+00	5.00E-02	6.65E-02	5.17E-03	mg/kg	5	4
		Methylnaphthalene, 1-	1.30E-01	3.70E+00	2.10E+00	6.65E-02	3.50E-01	1.49E-01	mg/kg	11	5

d:\mary\ftsher2\surplou\drftin\lchra\datasum\ecodasum.lst

1: mary\ftsher2\surplsou\drftfinl\bchrays\datasumm\ecodasum\ecodasum.1st

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 18

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Janes Extra	Acenaphthene	1.40E+00	1.78E+00	1.59E+00	6.65E-02	1.00E+00	3.02E-01	mg/kg	6	2
		Acenaphthylene	.	.	.	6.65E-02	1.00E+00	2.23E-01	mg/kg	6	0
		Acetone	.	.	.	5.00E-03	8.50E-03	5.88E-03	mg/kg	4	0
		Aldrin	.	.	.	1.50E-03	3.65E-03	2.04E-03	mg/kg	4	0
		Aluminum	2.07E+03	1.38E+04	8.30E+03	.	.	.	mg/kg	6	6
		Amino-2, 6-dinitrotoluene, 4-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Amino-4, 6-dinitrotoluene, 2-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Anthracene	1.35E-01	1.29E+00	6.52E-01	7.00E-02	1.00E+00	3.80E-01	mg/kg	6	3
		Antimony	.	.	.	1.90E+00	2.50E+00	2.40E+00	mg/kg	6	0
		Arsenic	2.28E+00	8.93E+00	5.53E+00	.	.	.	mg/kg	6	6
		Barium	5.58E+01	8.17E+01	6.68E+01	1.48E+01	2.00E+01	1.74E+01	mg/kg	6	4
		Benz(a)anthracene	4.20E-02	2.30E-01	1.51E-01	7.00E-02	4.00E+00	1.38E+00	mg/kg	6	3
		Benzene	5.40E-02	3.60E-01	2.21E-01	7.50E-04	5.00E-03	3.94E-03	mg/kg	4	0
		Benzo(a)pyrene	6.90E-02	4.30E-01	2.63E-01	7.00E-02	5.00E+00	1.71E+00	mg/kg	6	3
		Benzo(b)fluoranthene	8.50E-02	4.10E-01	2.48E-01	3.35E-02	5.00E+00	1.70E+00	mg/kg	6	3
		Benzo(ghi)perylene	2.80E-02	2.80E-01	1.49E-01	7.00E-02	5.00E+00	1.30E+00	mg/kg	6	2
		Benzo(k)fluoranthene	6.30E-01	6.30E-01	6.30E-01	7.00E-02	5.00E+00	5.47E-01	mg/kg	6	3
		Benzoic acid	6.30E-01	6.30E-01	6.30E-01	7.00E-02	5.00E+00	4.28E+00	mg/kg	5	1
		Benzyl alcohol	6.32E-01	7.28E-01	6.93E-01	7.00E-02	5.00E+00	8.63E+00	mg/kg	6	0
		Beryllium	.	.	.	1.00E-01	9.30E-01	3.77E-01	mg/kg	6	3
		Bis(2-chloroethoxy) methane	.	.	.	7.00E-02	1.50E+00	5.47E-01	mg/kg	6	0
		Bis(2-chloroethyl) ether	.	.	.	7.00E-02	1.50E+00	4.63E-01	mg/kg	6	0
		Bis(2-chloroisopropyl) ether	.	.	.	7.00E-02	5.00E+00	1.13E+00	mg/kg	6	0
		Bis(2-ethylhexyl) phthalate	6.50E-01	2.00E+00	1.32E+00	7.00E-02	5.00E+00	5.52E+00	mg/kg	6	3
		Bromodichloromethane	.	.	.	1.45E-03	5.00E-03	4.11E-03	mg/kg	4	0
		Bromoform	.	.	.	3.45E-03	5.00E-03	4.61E-03	mg/kg	4	0
		Bromomethane	.	.	.	2.85E-03	5.00E-03	4.46E-03	mg/kg	4	0
		Bromophenyl phenyl ether, 4-	.	.	.	7.00E-02	1.50E+00	4.63E-01	mg/kg	6	0
		Butylbenzyl phthalate	.	.	.	7.00E-02	4.00E+00	9.63E-01	mg/kg	6	0
		Cadmium	9.00E-01	9.00E-01	9.00E-01	2.50E-01	1.53E+00	5.05E-01	mg/kg	6	1
		Calcium	3.83E+03	1.50E+05	5.48E+04	.	.	.	mg/kg	6	6
		Carbazole	.	.	.	7.00E-02	1.50E+00	3.56E-01	mg/kg	5	0
		Carbon disulfide	.	.	.	2.20E-03	4.30E-03	4.30E-03	mg/kg	4	0
		Carbon tetrachloride	.	.	.	3.50E-03	5.00E-03	4.63E-03	mg/kg	4	0
		Chlordane, alpha-	3.25E-02	3.25E-02	3.25E-02	1.50E-03	1.50E-03	1.50E-03	mg/kg	3	1
		Chlordane, gamma-	2.85E-02	2.85E-02	2.85E-02	1.50E-03	1.50E-03	1.50E-03	mg/kg	3	1
		Chlordane, total	4.00E-01	4.00E-01	4.00E-01	8.85E-03	1.00E-02	9.62E-03	mg/kg	4	1
		Chloro-3-methylphenol, 4-	.	.	.	7.00E-02	2.50E+00	7.13E-01	mg/kg	6	0
		Chloroaniline, 4-	.	.	.	1.50E-01	2.00E+00	3.93E+00	mg/kg	6	0
		Chlorobenzene	.	.	.	4.30E-04	5.00E-03	3.86E-03	mg/kg	4	0
		Chloroethane	.	.	.	5.00E-03	5.00E-03	5.25E-03	mg/kg	4	0
		Chloroethylvinyl ether, 2-	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	3	0
		Chloroform	.	.	.	4.35E-04	5.00E-03	3.86E-03	mg/kg	4	0
		Chloromethane	.	.	.	4.40E-03	5.00E-03	4.85E-03	mg/kg	4	0
		Chloronaphthalene, 2-	.	.	.	7.00E-02	1.50E+00	4.63E-01	mg/kg	6	0
		Chlorophenol, 2-	.	.	.	7.00E-02	1.50E+00	4.63E-01	mg/kg	6	0
		Chlorophenyl phenyl ether, 4-	.	.	.	7.00E-02	1.50E+00	5.47E-01	mg/kg	6	0
		Chromium, total	7.38E+00	2.24E+01	1.68E+01	6.35E+00	6.35E+00	6.35E+00	mg/kg	6	5
		Chrysene	2.49E-02	1.00E-01	7.00E-02	7.00E-02	3.00E+00	1.05E+00	mg/kg	6	3
		Cobalt	7.38E+00	1.34E+01	1.05E+01	1.00E+00	7.50E+00	4.25E+00	mg/kg	6	4
		Copper	1.18E+01	2.68E+01	2.18E+01	2.93E+01	2.93E+01	2.93E+01	mg/kg	6	5
		Cyanide, total	.	.	.	1.25E-01	4.60E-01	2.93E-01	mg/kg	2	0
		DDD, p,p'-	1.50E-01	3.90E+00	2.03E+00	1.50E-03	1.50E-03	1.50E-03	mg/kg	4	2
		DDT, p,p'-	5.33E-03	2.10E-01	6.73E-02	.	.	.	mg/kg	4	4
		DDT, p,p'-	4.48E-03	3.90E+00	1.03E+00	.	.	.	mg/kg	4	4
		Dalapon	1.80E+00	1.00E+01	5.90E+00	5.00E-03	5.00E-03	5.00E-03	mg/kg	3	0
		Di-n-butyl phthalate	.	.	.	7.00E-02	1.50E+00	1.02E+00	mg/kg	6	3
		Di-n-octyl phthalate	.	.	.	7.00E-02	5.00E+00	8.63E+00	mg/kg	6	0
		Dibenz(ah)anthracene	9.40E-02	9.40E-02	9.40E-02	1.65E-02	5.00E+00	1.04E+00	mg/kg	6	1
		Dibenzofuran	.	.	.	7.00E-02	1.50E+00	4.63E-01	mg/kg	6	0

d:\mary\fisher2\surplou\drftfini\bchraws\datasum\ecodasum.lst



Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 19

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Janes Extra	Dibromochloromethane				1.55E-03	5.00E-03	4.14E-03	mg/kg	4	0
		Dicamba				5.00E-03	5.00E-03	5.00E-03	mg/kg	3	0
		Dichlorobenzene, 1,2-				7.00E-02	3.00E+00	7.97E-01	mg/kg	6	0
		Dichlorobenzene, 1,3-				7.00E-02	3.00E+00	7.97E-01	mg/kg	6	0
		Dichlorobenzene, 1,4-				7.00E-02	2.50E+00	7.13E-01	mg/kg	6	0
		Dichlorobenzidine, 3,3'-				3.35E-01	1.50E+02	2.61E+01	mg/kg	6	0
		Dichloroethane, 1,1-				1.45E-03	5.00E-03	4.04E-03	mg/kg	4	0
		Dichloroethane, 1,2-				8.50E-04	5.00E-03	3.96E-03	mg/kg	4	0
		Dichloroethene, 1,1-				1.95E-03	5.00E-03	4.24E-03	mg/kg	4	0
		Dichloroethene, 1,2-, total				1.50E-03	5.00E-03	4.13E-03	mg/kg	4	0
		Dichloropropene, 1,2-				7.00E-02	4.50E+00	1.05E+00	mg/kg	6	0
		Dichlorophenol, 2,4-				1.45E-03	5.00E-03	4.11E-03	mg/kg	4	0
		Dichloropropene, 1,3-, cis-				1.60E-03	5.00E-03	4.15E-03	mg/kg	4	0
		Dichloropropene, 1,3-, trans-				1.40E-03	5.00E-03	4.10E-03	mg/kg	4	0
		Dieldrin				5.00E-03	5.00E-03	5.00E-03	mg/kg	3	0
		Diethyl phthalate				1.50E-03	3.15E-03	1.91E-03	mg/kg	4	0
		Dimethyl phthalate				7.00E-02	5.00E+00	1.13E+00	mg/kg	6	0
		Dimethylphenol, 2,4-				7.00E-02	4.00E+00	9.63E-01	mg/kg	6	0
		Dinitro-2-methylphenol, 4,6-				7.00E-01	1.50E+01	2.80E+00	mg/kg	6	0
		Dinitrobenzene, 1,3-				1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Dinitrophenol, 2,4-				7.00E-01	3.00E+01	7.97E+00	mg/kg	6	0
		Dinitrotoluene, 2,4-				7.00E-02	3.50E+00	8.80E-01	mg/kg	6	0
		Dinitrotoluene, 2,6-				7.00E-02	2.00E+00	6.30E-01	mg/kg	6	0
		Dinoseb				5.00E-03	5.00E-03	5.00E-03	mg/kg	3	0
		Endosulfan A				1.50E-03	3.32E-03	1.95E-03	mg/kg	4	0
		Endosulfan B				1.50E-03	3.82E-03	2.08E-03	mg/kg	4	0
		Endosulfan sulfate				1.50E-03	3.29E-03	1.95E-03	mg/kg	4	0
		Endrin				1.10E-02	1.20E-02	1.13E-02	mg/kg	4	0
		Endrin aldehyde				1.50E-03	1.50E-03	1.50E-03	mg/kg	3	0
		Endrin ketone				8.50E-04	5.00E-03	3.96E-03	mg/kg	4	0
		Ethylbenzene	1.00E-01	6.50E-01	3.97E-01	7.00E-02	1.50E+00	5.47E-01	mg/kg	6	3
		Fluoranthene	2.04E-01	2.99E-01	2.52E-01	1.65E-02	1.00E+00	2.89E-01	mg/kg	6	2
		Fluorene				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		HMX				1.50E-03	3.09E-03	1.90E-03	mg/kg	4	0
		Heptachlor				1.50E-03	3.10E-03	1.90E-03	mg/kg	4	0
		Heptachlor epoxide				7.00E-02	1.50E+00	4.63E-01	mg/kg	6	0
		Hexachlorobenzene				7.00E-02	5.00E+00	1.13E+00	mg/kg	6	0
		Hexachlorobutadiene				1.50E-03	4.54E-03	2.26E-03	mg/kg	4	0
		Hexachlorocyclohexane, alpha-				1.29E-03	1.50E-03	1.45E-03	mg/kg	4	0
		Hexachlorocyclohexane, beta-				1.50E-03	2.78E-03	1.82E-03	mg/kg	4	0
		Hexachlorocyclohexane, delta-				1.50E-03	3.19E-03	1.92E-03	mg/kg	4	0
		Hexachlorocyclohexane, gamma-				5.00E-01	1.50E+02	2.70E+01	mg/kg	6	0
		Hexachlorocyclopentadiene				7.00E-02	4.00E+00	9.63E-01	mg/kg	6	2
		Hexachloroethane				1.65E-02	5.00E+00	1.29E+00	mg/kg	6	6
		Indeno(1,2,3-cd)pyrene	1.50E-01	2.40E-01	1.95E-01	2.31E-03	2.31E-03	2.31E-03	mg/kg	1	0
		Iron	4.98E+03	3.10E+04	1.64E+04	7.00E-02	1.50E+00	4.63E-01	mg/kg	6	0
		Isodrin				7.00E-02	1.50E+00	4.63E-01	mg/kg	6	0
		Isophorone				1.00E-01	1.00E-01	1.00E-01	mg/kg	3	0
		Lead	1.99E+01	1.04E+02	4.50E+01	1.00E-01	1.00E-01	1.00E-01	mg/kg	3	0
		MCPA				1.00E-01	1.00E-01	1.00E-01	mg/kg	6	6
		MCPP				1.00E-01	1.00E-01	1.00E-01	mg/kg	6	6
		Magnesium	4.64E+03	7.60E+04	3.13E+04	5.00E-02	5.00E-02	5.00E-02	mg/kg	6	2
		Manganese	2.64E+02	8.79E+02	5.71E+02	1.50E-03	3.56E-02	1.00E-02	mg/kg	4	0
		Mercury	1.95E+00	2.30E+00	2.13E+00	5.00E-03	1.25E-02	1.25E-02	mg/kg	4	0
		Methoxychlor				5.00E-03	1.35E-02	7.13E-03	mg/kg	4	0
		Methyl ethyl ketone				5.00E-03	1.50E-02	7.13E-03	mg/kg	4	0
		Methyl isobutyl ketone				5.00E-03	1.60E-02	7.75E-03	mg/kg	4	0
		Methyl n-butyl ketone				5.00E-03	6.00E-03	5.25E-03	mg/kg	4	0
		Methylene chloride				5.00E-03	6.65E-02	6.65E-02	mg/kg	3	1
		Methylnaphthalene, 1-	2.58E-01	2.58E-01	2.58E-01	6.65E-02	7.00E-02	6.88E-02	mg/kg	6	3
		Methylnaphthalene, 2-	1.06E+00	8.00E+00	3.39E+00	7.00E-02	1.50E+00	3.80E-01	mg/kg	6	0
		Methylphenol, 2-				7.00E-02	1.50E+00	3.80E-01	mg/kg	6	0

d:\mary\ftsher2\surplusou\drftfinl\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 20

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	James Extra	Methylphenol, 4-				7.00E-02	5.00E+00	1.13E+00	mg/kg	6	0
		Naphthalene	4.02E-01	6.87E-01	5.45E-01	6.65E-02	1.00E+00	3.02E-01	mg/kg	6	2
		Nickel	7.07E+00	3.34E+01	2.21E+01	6.30E+00	6.30E+00	6.30E+00	mg/kg	6	5
		Nitroaniline, 2-				3.35E-01	5.00E+00	1.31E+00	mg/kg	6	0
		Nitroaniline, 3-				3.35E-01	1.00E+01	2.72E+00	mg/kg	6	0
		Nitroaniline, 4-				3.35E-01	1.00E+01	2.72E+00	mg/kg	6	0
		Nitrobenzene				7.00E-02	1.50E+00	4.63E-01	mg/kg	6	0
		Nitrophenol, 2-				7.00E-02	3.50E+00	8.80E-01	mg/kg	6	0
		Nitrophenol, 4-				7.00E-01	3.50E+01	8.80E+00	mg/kg	6	0
		Nitrosodi-N-propylamine, N-				7.00E-02	5.00E+00	1.13E+00	mg/kg	6	0
		Nitrosodiphenylamine, N-				7.00E-02	5.00E+01	8.63E+00	mg/kg	6	0
		Nitrotoluene, 2-				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Nitrotoluene, 3-				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Nitrotoluene, 4-				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		PCB 1016				6.50E-03	3.33E-02	1.32E-02	mg/kg	4	0
		PCB 1221				6.50E-03	6.50E-03	6.50E-03	mg/kg	3	0
		PCB 1232				6.50E-03	6.50E-03	6.50E-03	mg/kg	3	0
		PCB 1242				6.50E-03	6.50E-03	6.50E-03	mg/kg	3	0
		PCB 1248				6.50E-03	6.50E-03	6.50E-03	mg/kg	3	0
		PCB 1254				6.50E-03	6.50E-03	6.50E-03	mg/kg	3	0
		PCB 1260				4.02E-02	1.49E-02	1.49E-02	mg/kg	4	0
		Pentachlorophenol				3.35E-01	3.00E+01	6.06E+00	mg/kg	6	0
		Petroleum hydrocarbons, total (TPH)	6.74E+01	4.32E+02	2.35E+02				mg/kg	5	5
		Phenanthrene	1.10E-01	3.66E-01	2.47E-01	7.00E-02	1.00E+00	3.80E-01	mg/kg	6	3
		Phenol				7.00E-02	3.00E+00	7.97E-01	mg/kg	6	0
		Potassium	4.43E+02	3.07E+03	1.50E+03				mg/kg	6	6
		Pyrene	2.62E-01	1.30E+00	9.21E-01				mg/kg	6	3
		RDX				7.00E-02	1.00E+00	3.80E-01	mg/kg	6	3
		Selenium				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Silver				1.25E-01	1.25E-01	1.25E-01	mg/kg	6	0
		Silvex (2,4,5-TP)				2.50E-01	1.25E+00	4.17E-01	mg/kg	6	0
		Sodium	4.19E+02	6.97E+02	6.08E+02	4.25E-03	5.00E-03	4.81E-03	mg/kg	4	6
		Styrene				1.30E-03	5.00E-03	4.08E-03	mg/kg	4	0
		Tetrachloroethane, 1,1,2,2-				1.20E-03	5.00E-03	4.05E-03	mg/kg	4	0
		Tetrachloroethene				4.05E-04	5.00E-03	3.85E-03	mg/kg	4	0
		Tetryl				2.50E-01	2.50E-01	2.50E-01	mg/kg	1	0
		Thallium	3.75E-01	4.99E-01	4.37E-01	1.25E-01	1.25E-01	1.25E-01	mg/kg	5	2
		Toluene	1.40E-03	1.40E-03	1.40E-03	5.00E-03	5.00E-03	5.00E-03	mg/kg	4	1
		Toxaphene				1.50E-01	2.22E-01	1.68E-01	mg/kg	4	0
		Trichlorobenzene, 1,2,4-				7.00E-02	1.50E+00	4.63E-01	mg/kg	6	0
		Trichloroethane, 1,1,1-				2.20E-03	5.00E-03	4.30E-03	mg/kg	4	0
		Trichloroethane, 1,1,2-				2.70E-03	5.00E-03	4.43E-03	mg/kg	4	0
		Trichloroethene				1.40E-03	5.00E-03	4.10E-03	mg/kg	4	0
		Trichlorofluoromethane				2.95E-03	2.95E-03	2.95E-03	mg/kg	1	0
		Trichlorophenol, 2,4,5-				1.50E-01	3.00E+00	1.02E+00	mg/kg	6	0
		Trichlorophenol, 2,4,6-				1.50E-01	4.00E+00	1.27E+00	mg/kg	6	0
		Trinitrotoluene, 2,4,6-				1.25E-01	1.25E-01	1.25E-01	mg/kg	1	0
		Triphenylene	2.13E-01	3.15E-01	2.64E-01				mg/kg	2	2
		Vanadium	6.90E+00	3.20E+01	2.28E+01	6.50E+00	6.50E+00	6.50E+00	mg/kg	6	5
		Vinyl acetate				1.60E-03	5.00E-03	4.15E-03	mg/kg	4	0
		Vinyl chloride				3.10E-03	5.00E-03	4.53E-03	mg/kg	4	0
		Xylenes, total	1.80E-02	1.80E-02	1.80E-02	5.00E-03	5.00E-03	5.00E-03	mg/kg	4	1
		Zinc	8.76E+01	3.75E+02	1.90E+02				mg/kg	6	6
Sediment	James Ravine	2,4,5-T				5.00E-03	5.00E-03	5.00E-03	mg/kg	1	0
		2,4-D				5.00E-03	8.85E-03	7.57E-03	mg/kg	3	0
		2,4-DB				5.00E-03	5.00E-03	5.00E-03	mg/kg	1	0
		Acenaphthene	1.60E-01	1.60E-01	1.60E-01	1.80E-02	7.00E-02	4.92E-02	mg/kg	6	1
		Acenaphthylene				1.65E-02	7.00E-02	5.16E-02	mg/kg	6	0
		Acetone				5.00E-03	8.50E-03	7.33E-03	mg/kg	3	0

d:\mary\fisher2\surplsol\drftfin\bcbravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 21

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	James Ravine	Acrolein	.	.	.	5.00E-02	5.00E-02	5.00E-02	mg/kg	2	0
		Acrylonitrile	.	.	.	5.00E-02	5.00E-02	5.00E-02	mg/kg	2	0
		Aldrin	.	.	.	1.50E-03	3.65E-03	2.22E-03	mg/kg	6	0
		Aluminum	2.95E+03	8.40E+03	5.48E+03	7.45E+02	1.49E+03	1.12E+03	mg/kg	6	4
		Amino-2,6-dinitrotoluene, 4-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	3	0
		Anthracene	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	3	0
		Antimony	5.37E-02	5.37E-02	5.37E-02	1.65E-02	7.00E-02	4.86E-02	mg/kg	6	1
		Arsenic	9.23E+00	9.23E+00	9.23E+00	1.90E+00	2.50E+00	2.26E+00	mg/kg	6	1
		Barium	3.26E+00	1.57E+01	7.21E+00	1.48E+01	2.00E+01	1.90E+01	mg/kg	6	6
		Benz(a)anthracene	1.13E+02	1.13E+02	1.13E+02	1.60E-02	8.50E-02	6.60E-02	mg/kg	6	1
		Benzene	.	.	.	7.50E-04	5.00E-03	2.17E-03	mg/kg	3	0
		Benzidine	.	.	.	4.25E-01	4.25E-01	4.25E-01	mg/kg	2	0
		Benzo(a)pyrene	3.20E-02	3.20E-02	3.20E-02	7.00E-02	1.25E-01	9.20E-02	mg/kg	6	1
		Benzo(b)fluoranthene	4.60E-02	4.60E-02	4.60E-02	7.00E-02	1.05E-01	8.40E-02	mg/kg	6	1
		Benzo(ghi)perylene	2.03E-02	2.03E-02	2.03E-02	8.00E-02	1.25E-01	9.80E-02	mg/kg	6	1
		Benzo(k)fluoranthene	1.70E-01	1.70E-01	1.70E-01	9.00E-03	7.00E-02	5.04E-02	mg/kg	6	1
		Benzoic acid	.	.	.	7.00E-01	3.05E+00	1.48E+00	mg/kg	6	0
		Benzyl alcohol	.	.	.	7.00E-02	9.50E-02	7.83E-02	mg/kg	6	0
		Beryllium	2.96E-01	6.39E-01	3.94E-01	9.30E-01	9.30E-01	9.30E-01	mg/kg	6	4
		Bis(2-chloroethoxy) methane	.	.	.	2.95E-02	7.00E-02	5.65E-02	mg/kg	6	0
		Bis(2-chloroethyl) ether	.	.	.	1.65E-02	7.00E-02	5.22E-02	mg/kg	6	0
		Bis(2-chloroisopropyl) ether	.	.	.	7.00E-02	1.00E-01	8.00E-02	mg/kg	6	0
		Bis(2-ethylhexyl) phthalate	1.70E-01	5.20E-01	3.45E-01	7.00E-02	3.10E-01	1.90E-01	mg/kg	6	2
		Bromodichloromethane	.	.	.	1.45E-03	5.00E-03	2.53E-03	mg/kg	3	0
		Bromoform	.	.	.	3.45E-03	5.00E-03	3.97E-03	mg/kg	3	0
		Bromomethane	.	.	.	2.85E-03	5.00E-03	3.57E-03	mg/kg	3	0
		Bromophenyl phenyl ether, 4-	.	.	.	1.65E-02	7.00E-02	5.22E-02	mg/kg	6	0
		Butylbenzyl phthalate	.	.	.	7.00E-02	8.50E-02	7.50E-02	mg/kg	6	0
		Cadmium	.	.	.	2.50E-01	1.53E+00	6.75E-01	mg/kg	6	0
		Calcium	2.58E+04	1.00E+05	5.19E+04	.	.	.	mg/kg	6	6
		Carbazole	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	4	0
		Carbon disulfide	.	.	.	2.20E-03	5.00E-03	3.13E-03	mg/kg	3	0
		Carbon tetrachloride	.	.	.	3.50E-03	5.00E-03	4.00E-03	mg/kg	3	0
		Chlordane, alpha-	.	.	.	1.50E-03	1.65E-01	5.69E-02	mg/kg	6	0
		Chlordane, gamma-	.	.	.	1.50E-03	1.65E-01	5.69E-02	mg/kg	6	0
		Chlordane, total	3.06E-02	5.20E-00	1.34E+00	8.85E-03	1.00E-02	9.43E-03	mg/kg	6	4
		Chloro-3-methylphenol, 4-	.	.	.	4.75E-02	7.00E-02	6.25E-02	mg/kg	6	0
		Chloroaniline, 4-	.	.	.	1.50E-01	4.05E-01	2.35E-01	mg/kg	6	0
		Chlorobenzene	.	.	.	4.30E-04	5.00E-03	1.95E-03	mg/kg	3	0
		Chloroethane	.	.	.	5.00E-03	6.00E-03	5.67E-03	mg/kg	3	0
		Chloroethylvinyl ether, 2-	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	3	0
		Chloroform	.	.	.	4.35E-04	5.00E-03	1.96E-03	mg/kg	3	0
		Chloromethane	.	.	.	4.40E-03	5.00E-03	4.60E-03	mg/kg	3	0
		Chloronaphthalene, 2-	.	.	.	1.80E-02	7.00E-02	5.27E-02	mg/kg	6	0
		Chlorophenol, 2-	.	.	.	3.00E-02	7.00E-02	5.67E-02	mg/kg	6	0
		Chlorophenyl phenyl ether, 4-	.	.	.	1.65E-02	7.00E-02	5.22E-02	mg/kg	6	0
		Chromium, total	3.82E+00	8.50E+00	5.96E+00	3.06E+00	6.35E+00	5.25E+00	mg/kg	6	3
		Chrysene	1.67E-01	3.30E-01	2.49E-01	6.00E-02	7.00E-02	6.75E-02	mg/kg	6	2
		Cobalt	4.15E+00	1.06E+01	8.43E+00	7.50E+00	7.50E+00	7.50E+00	mg/kg	6	4
		Copper	1.12E+01	1.94E+01	1.39E+01	2.93E+01	2.93E+01	2.93E+01	mg/kg	6	4
		Cyanide, total	.	.	.	1.25E-01	4.60E-01	2.37E-01	mg/kg	6	0
		DDO, p,p'-	7.30E-02	6.60E+00	1.43E+00	4.13E-03	4.13E-03	4.13E-03	mg/kg	6	5
		DDT, p,p'-	1.96E-02	4.80E-01	1.35E-01	3.83E-03	3.83E-03	3.83E-03	mg/kg	6	5
		DDT, p,p'-	4.30E-02	5.90E+00	1.25E+00	3.54E-03	3.54E-03	3.54E-03	mg/kg	6	5
		Dalapon	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	1	0
		Di-n-butyl phthalate	.	.	.	7.00E-02	7.00E-02	5.68E-02	mg/kg	6	0
		Di-n-octyl phthalate	.	.	.	7.00E-02	9.50E-02	7.83E-02	mg/kg	6	0
		Dibenz(ah)anthracene	6.24E-03	6.24E-03	6.24E-03	1.05E-02	1.05E-02	9.00E-02	mg/kg	6	1
		Dibenzofuran	.	.	.	1.75E-02	7.00E-02	5.25E-02	mg/kg	6	0

d:\mary\ftsher2\surplsou\drftfini\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 22

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Janes Ravine	Dibromochloromethane	.	.	.	1.55E-03	5.00E-03	2.70E-03	mg/kg	3	0
		Dicamba	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	1	0
		Dichlorobenzene, 1,2-	.	.	.	5.50E-02	7.00E-02	6.50E-02	mg/kg	6	0
		Dichlorobenzene, 1,3-	.	.	.	6.50E-02	7.00E-02	6.83E-02	mg/kg	6	0
		Dichlorobenzene, 1,4-	.	.	.	6.50E-02	7.00E-02	6.30E-02	mg/kg	6	0
		Dichlorobenzenes, total	.	.	.	5.00E-02	5.00E-02	5.00E-02	mg/kg	2	0
		Dichlorobenzidine, 3,3'-	.	.	.	3.35E-01	3.15E+00	1.27E+00	mg/kg	6	0
		Dichloroethane, 1,1-	.	.	.	1.15E-03	5.00E-03	2.43E-03	mg/kg	3	0
		Dichloroethane, 1,2-	.	.	.	8.50E-04	5.00E-03	2.23E-03	mg/kg	3	0
		Dichloroethane, 1,1-	.	.	.	1.95E-03	5.00E-03	2.97E-03	mg/kg	3	0
		Dichloroethenes, 1,2-, total	.	.	.	1.50E-03	5.00E-03	2.67E-03	mg/kg	3	0
		Dichlorophenol, 2,4-	.	.	.	7.00E-02	9.00E-02	7.67E-02	mg/kg	6	0
		Dichloropropane, 1,2-	.	.	.	1.45E-03	5.00E-03	2.63E-03	mg/kg	3	0
		Dichloropropene, 1,3-, cis-	.	.	.	1.60E-03	5.00E-03	2.73E-03	mg/kg	3	0
		Dichloropropene, 1,3-, trans-	.	.	.	5.00E-03	5.00E-03	2.60E-03	mg/kg	3	0
		Dichloroprop	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	1	0
		Dieldrin	.	.	.	1.50E-03	3.15E-03	2.05E-03	mg/kg	6	0
		Diethyl phthalate	.	.	.	7.00E-02	1.20E-01	8.67E-02	mg/kg	6	0
		Dimethyl phthalate	.	.	.	7.00E-02	8.50E-02	7.50E-02	mg/kg	6	0
		Dimethylphenol, 2,4-	.	.	.	2.75E-01	7.00E-01	5.58E-01	mg/kg	6	0
		Dinitro-2-methylphenol, 4,6-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	3	0
		Dinitrobenzene, 1,3-	.	.	.	6.00E-01	7.00E-02	6.67E-01	mg/kg	6	0
		Dinitrophenol, 2,4-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	6	0
		Dinitrotoluene, 2,6-	.	.	.	4.25E-02	7.00E-02	6.08E-02	mg/kg	6	0
		Dinoseb	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/kg	1	0
		Diphenylhydrazine, 1,2-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	2	0
		Endosulfan A	.	.	.	1.50E-03	3.01E-03	2.00E-03	mg/kg	6	0
		Endosulfan B	.	.	.	1.50E-03	3.32E-03	2.11E-03	mg/kg	6	0
		Endosulfan sulfate	.	.	.	1.50E-03	3.82E-03	2.27E-03	mg/kg	6	0
		Endrin	.	.	.	1.50E-03	3.20E-02	7.05E-03	mg/kg	6	0
		Endrin aldehyde	.	.	.	1.10E-02	1.13E-02	1.13E-02	mg/kg	6	0
		Endrin ketone	.	.	.	2.65E-01	8.93E-02	8.93E-02	mg/kg	6	0
		Ethylbenzene	.	.	.	5.00E-03	5.00E-03	2.23E-03	mg/kg	3	0
		Fluoranthene	.	.	.	3.40E-02	7.00E-02	5.80E-02	mg/kg	6	3
		Fluorene	1.60E-01	4.40E-01	2.53E-01	1.65E-02	7.00E-02	4.33E-02	mg/kg	6	0
		HMX	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	3	0
		Heptachlor	.	.	.	1.50E-03	3.10E-02	6.68E-03	mg/kg	6	0
		Heptachlor epoxide	.	.	.	1.50E-03	3.10E-02	2.03E-03	mg/kg	6	0
		Hexachlorobenzene	.	.	.	1.65E-02	7.00E-02	5.22E-02	mg/kg	6	0
		Hexachlorobutadiene	.	.	.	7.00E-02	1.15E-01	8.50E-02	mg/kg	6	0
		Hexachlorocyclohexane, alpha-	.	.	.	1.50E-03	4.54E-03	2.51E-03	mg/kg	6	0
		Hexachlorocyclohexane, beta-	.	.	.	1.29E-03	1.50E-03	1.43E-03	mg/kg	6	0
		Hexachlorocyclohexane, delta-	.	.	.	1.50E-03	2.78E-03	1.93E-03	mg/kg	6	0
		Hexachlorocyclohexane, gamma-	.	.	.	1.50E-03	3.19E-03	1.92E-03	mg/kg	6	2
		Hexachlorocyclopentadiene	7.29E-03	7.10E-02	3.91E-02	5.00E-01	3.10E+00	1.37E+00	mg/kg	6	0
		Hexachloroethane	.	.	.	7.00E-02	7.50E-02	7.17E-02	mg/kg	6	0
		Indeno(1,2,3-cd)pyrene	.	.	.	4.10E-02	1.45E-01	9.52E-02	mg/kg	6	0
		Iron	7.42E+03	2.30E+04	1.52E+04	.	.	.	mg/kg	6	6
		Isodrin	.	.	.	2.31E-03	2.31E-03	2.31E-03	mg/kg	2	0
		Isophorone	.	.	.	1.65E-02	7.00E-02	5.22E-02	mg/kg	6	0
		Lead	7.02E+00	3.00E+01	1.36E+01	.	.	.	mg/kg	6	6
		MCPA	.	.	.	1.00E-01	1.00E-01	1.00E-01	mg/kg	1	0
		MCPP	.	.	.	1.00E-01	1.00E-01	1.00E-01	mg/kg	1	0
		Magnesium	1.36E+04	5.00E+04	2.66E+04	.	.	.	mg/kg	6	6
		Manganese	3.32E+02	2.04E+03	8.89E+02	.	.	.	mg/kg	6	6
		Mercury	1.06E-01	1.06E-01	1.06E-01	2.50E-02	5.00E-02	4.17E-02	mg/kg	6	0
		Methoxychlor	.	.	.	1.50E-03	3.56E-02	8.31E-03	mg/kg	6	1
		Methyl ethyl ketone	.	.	.	5.00E-03	3.50E-02	2.50E-02	mg/kg	3	0
		Methyl isobutyl ketone	.	.	.	1.35E-02	1.35E-02	1.07E-02	mg/kg	3	0
		Methyl n-butyl ketone	.	.	.	5.00E-03	1.60E-02	1.23E-02	mg/kg	3	0
		Methylene chloride	.	.	.	5.00E-03	6.00E-03	5.67E-03	mg/kg	3	0
		Methylnaphthalene, 1-	.	.	.	6.65E-02	6.65E-02	6.65E-02	mg/kg	1	0

d:\mary\ftsher2\surplson\drftfinl\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 23

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Janes Ravine	Methylnaphthalene, 2-	3.70E-01	3.70E-01	3.70E-01	2.45E-02	7.00E-02	6.09E-02	mg/kg	6	1
		Methylphenol, 2-	.	.	.	1.45E-02	7.00E-02	5.15E-02	mg/kg	6	0
		Methylphenol, 4-	.	.	.	7.00E-02	1.20E-01	8.67E-02	mg/kg	6	0
		Naphthalene	1.50E-01	1.72E-01	1.61E-01	1.85E-02	7.00E-02	5.71E-02	mg/kg	6	2
		Nickel	8.00E+00	3.84E+01	2.15E+01	.	.	.	mg/kg	6	6
		Nitroaniline, 2-	.	.	.	3.10E-02	3.35E-01	2.34E-01	mg/kg	6	0
		Nitroaniline, 3-	.	.	.	2.25E-01	3.35E-01	2.98E-01	mg/kg	6	0
		Nitroaniline, 4-	.	.	.	2.05E-01	3.35E-01	2.92E-01	mg/kg	6	0
		Nitrobenzene	.	.	.	2.25E-02	7.00E-02	5.42E-02	mg/kg	6	0
		Nitrophenol, 2-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	6	0
		Nitrophenol, 4-	.	.	.	7.00E-01	7.00E-01	7.00E-01	mg/kg	6	0
		Nitrosodi-N-propylamine, N-	.	.	.	7.00E-02	1.00E-01	8.00E-02	mg/kg	6	0
		Nitrosodimethylamine, N-	.	.	.	7.00E-02	7.00E-02	7.00E-02	mg/kg	2	0
		Nitrosodiphenylamine, N-	.	.	.	7.00E-02	9.50E-02	7.83E-02	mg/kg	6	0
		Nitrotoluene, 2-	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	3	0
		Nitrotoluene, 3-	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	3	0
		Nitrotoluene, 4-	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	3	0
		Organic carbon, total (TOC)	2.89E+04	3.69E+04	3.29E+04	.	.	.	mg/kg	3	3
		PCB 1016	.	.	.	6.50E-03	3.35E-01	6.57E-02	mg/kg	6	0
		PCB 1221	.	.	.	6.50E-03	4.10E-01	7.95E-02	mg/kg	6	0
		PCB 1232	.	.	.	6.50E-03	4.10E-01	7.95E-02	mg/kg	6	0
		PCB 1242	.	.	.	6.50E-03	4.10E-01	7.95E-02	mg/kg	6	0
		PCB 1248	.	.	.	6.50E-03	4.10E-01	7.95E-02	mg/kg	6	0
		PCB 1254	.	.	.	6.50E-03	4.10E-01	7.95E-02	mg/kg	6	0
		PCB 1260	.	.	.	6.50E-03	4.10E-01	7.95E-02	mg/kg	6	0
		Pentachlorophenol	7.80E+01	7.80E+01	7.80E+01	3.35E-01	6.50E-01	4.40E-01	mg/kg	6	0
		Petroleum hydrocarbons, total (TPH)	7.80E+01	7.80E+01	7.80E+01	.	.	.	mg/kg	1	1
		Phenanthrene	4.60E-02	3.01E-01	1.99E-01	7.00E-02	7.00E-02	7.00E-02	mg/kg	6	3
		Phenol	.	.	.	5.50E-02	7.00E-02	6.50E-02	mg/kg	6	0
		Potassium	1.38E+03	2.77E+03	2.08E+03	1.50E+02	3.91E+02	2.52E+02	mg/kg	6	2
		Pyrene	1.84E-01	5.30E-01	3.57E-01	1.65E-02	7.00E-02	5.66E-02	mg/kg	6	2
		RDX	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	3	0
		Selenium	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	6	0
		Silver	6.30E-01	6.30E-01	6.30E-01	2.50E-01	1.25E+00	6.50E-01	mg/kg	6	1
		Silvex (2,4,5-TP)	.	.	.	4.25E-03	5.00E-03	4.50E-03	mg/kg	3	0
		Sodium	4.44E+02	6.30E+02	5.39E+02	.	.	.	mg/kg	6	6
		Styrene	.	.	.	1.30E-03	5.00E-03	2.53E-03	mg/kg	3	0
		Tetrachloroethane, 1,1,2,2-	.	.	.	1.20E-03	5.00E-03	2.47E-03	mg/kg	3	0
		Tetrachloroethene	.	.	.	4.05E-04	5.00E-03	1.94E-03	mg/kg	3	0
		Tetryl	.	.	.	2.50E-01	2.50E-01	2.50E-01	mg/kg	3	0
		Thallium	3.26E-01	4.02E-01	3.64E-01	1.25E-01	1.25E-01	1.25E-01	mg/kg	4	2
		Toluene	.	.	.	3.90E-04	5.00E-03	1.93E-03	mg/kg	3	0
		Toxaphene	.	.	.	1.50E-01	2.22E-01	1.74E-01	mg/kg	6	0
		Trichlorobenzene, 1,2,4-	.	.	.	2.00E-02	7.00E-02	5.33E-02	mg/kg	6	0
		Trichloroethane, 1,1,1-	.	.	.	2.20E-03	5.00E-03	3.13E-03	mg/kg	3	0
		Trichloroethane, 1,1,2-	.	.	.	2.70E-03	5.00E-03	3.47E-03	mg/kg	3	0
		Trichloroethene	.	.	.	1.40E-03	5.00E-03	2.60E-03	mg/kg	3	0
		Trichlorofluoromethane	.	.	.	2.95E-03	2.95E-03	2.95E-03	mg/kg	2	0
		Trichlorophenol, 2,4,5-	.	.	.	5.00E-02	1.50E-01	1.17E-01	mg/kg	6	0
		Trichlorophenol, 2,4,6-	.	.	.	8.50E-02	1.50E-01	1.28E-01	mg/kg	6	0
		Trinitrobenzene, 1,3,5-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	3	0
		Trinitrotoluene, 2,4,6-	.	.	.	1.25E-01	1.25E-01	1.25E-01	mg/kg	3	0
		Vanadium	6.76E+00	4.12E+01	1.99E+01	7.25E+00	7.25E+00	7.25E+00	mg/kg	6	5
		Vinyl acetate	.	.	.	1.60E-03	5.00E-03	2.73E-03	mg/kg	3	0
		Vinyl chloride	.	.	.	3.10E-03	5.00E-03	3.73E-03	mg/kg	3	0
		Xylenes, total	2.60E+01	1.55E+02	6.89E+01	7.50E-04	5.00E-03	2.17E-03	mg/kg	3	0
		Zinc	.	.	.	1.51E+01	1.51E+01	1.51E+01	mg/kg	6	5
Sediment	Lake Michigan	Acenaphthene	.	.	.	6.65E-02	6.65E-02	6.65E-02	mg/kg	2	0
		Acenaphthylene	.	.	.	6.65E-02	6.65E-02	6.65E-02	mg/kg	2	0

d:\mary\fisher2\surplsum\drftfinl\bchra\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 24

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Sediment	Lake Michigan	Aluminum	1.43E+03	1.45E+03	1.44E+03				mg/kg	2	2
		Amino-2,6-dinitrotoluene, 4-				1.25E-01	1.25E-01	1.25E-01	mg/kg	2	0
		Amino-4,6-dinitrotoluene, 2-Anthracene				1.25E-01	1.25E-01	1.25E-01	mg/kg	2	0
		Antimony				3.35E-03	3.35E-03	3.35E-03	mg/kg	2	0
		Arsenic				2.50E+00	2.50E+00	2.50E+00	mg/kg	2	0
		Barium	2.79E+00	3.04E+00	2.92E+00				mg/kg	2	0
		Benz(a)anthracene				2.00E+01	2.00E+01	2.00E+01	mg/kg	2	0
		Benzo(a)pyrene	1.88E-03	2.87E-03	2.38E-03				mg/kg	2	2
		Benzo(b)fluoranthene	1.72E-03	2.76E-03	2.24E-03				mg/kg	2	2
		Benzo(g,h,i)perylene	2.71E-03	3.56E-03	3.14E-03				mg/kg	2	2
		Benzok(k)fluoranthene	1.05E-03	1.51E-03	1.28E-03	3.35E-03	3.35E-03	3.35E-03	mg/kg	2	0
		Beryllium	3.41E-01	3.41E-01	3.41E-01	1.00E-01	1.00E-01	1.00E-01	mg/kg	2	1
		Cadmium				2.50E-01	2.50E-01	2.50E-01	mg/kg	2	0
		Calcium	4.58E+04	5.47E+04	5.03E+04				mg/kg	2	2
		Chromium, total	4.08E+00	4.63E+00	4.36E+00				mg/kg	2	2
		Chrysene	1.36E-02	1.36E-02	1.36E-02	3.35E-03	3.35E-03	3.35E-03	mg/kg	2	1
		Cobalt				1.00E+00	1.00E+00	1.00E+00	mg/kg	2	0
		Copper	6.74E+00	7.37E+00	7.06E+00				mg/kg	2	2
		Dibenz(ah)anthracene				1.65E-03	1.65E-03	1.65E-03	mg/kg	2	0
		Dinitrobenzene, 1,3-	2.97E-01	2.97E-01	2.97E-01	1.25E-01	1.25E-01	1.25E-01	mg/kg	2	1
		Dinitrotoluene, 2,4-				1.00E-01	1.00E-01	1.00E-01	mg/kg	2	0
		Dinitrotoluene, 2,6-				1.00E-01	1.00E-01	1.00E-01	mg/kg	2	0
		Dinitrotoluene, 3,4-Fluoranthene	4.22E+00	4.24E+00	4.23E+00				mg/kg	2	2
		Fluorene	4.73E-03	8.94E-03	6.84E-03				mg/kg	2	2
		HMX				1.65E-02	1.65E-02	1.65E-02	mg/kg	2	0
		Indeno(1,2,3-cd)pyrene				2.50E-01	2.50E-01	2.50E-01	mg/kg	2	0
		Iron	3.92E-03	3.92E-03	3.92E-03	1.65E-03	1.65E-03	1.65E-03	mg/kg	2	1
		Lead	5.69E+03	6.85E+03	6.27E+03				mg/kg	2	2
		Magnesium	3.59E+00	5.46E+00	4.53E+00				mg/kg	2	2
		Manganese	2.32E+04	3.19E+04	2.76E+04				mg/kg	2	2
		Mercury	2.77E+02	3.60E+02	3.19E+02				mg/kg	2	2
		Methylnaphthalene, 1-				5.00E-02	5.00E-02	5.00E-02	mg/kg	2	0
		Methylnaphthalene, 2-Naphthalene				6.65E-02	6.65E-02	6.65E-02	mg/kg	2	0
		Nickel	4.68E+00	4.89E+00	4.79E+00				mg/kg	2	2
		Nitrobenzene				1.25E-01	1.25E-01	1.25E-01	mg/kg	2	0
		Nitrotoluene, 2-				2.50E-01	2.50E-01	2.50E-01	mg/kg	2	0
		Nitrotoluene, 3-				2.50E-01	2.50E-01	2.50E-01	mg/kg	2	0
		Nitrotoluene, 4-				2.50E-01	2.50E-01	2.50E-01	mg/kg	2	0
		Phenanthrene				1.65E-02	1.65E-02	1.65E-02	mg/kg	2	0
		Potassium	2.54E+02	3.07E+02	2.81E+02				mg/kg	2	2
		Pyrene	8.44E-03	8.58E-03	8.51E-03				mg/kg	2	2
		RDX				2.50E-01	2.50E-01	2.50E-01	mg/kg	2	0
		Selenium				1.25E-01	1.25E-01	1.25E-01	mg/kg	2	0
		Silver				2.50E-01	2.50E-01	2.50E-01	mg/kg	2	0
		Sodium	3.44E+02	3.82E+02	3.63E+02				mg/kg	2	2
		Tetryl				2.50E-01	2.50E-01	2.50E-01	mg/kg	2	0
		Thallium				1.25E-01	1.25E-01	1.25E-01	mg/kg	2	0
		Trinitrotoluene, 2,4,6-Triphenylene	2.92E-01	2.92E-01	2.92E-01				mg/kg	2	2
		Vanadium	7.14E+00	1.34E+01	1.03E+01				mg/kg	2	2
		Zinc	2.23E+01	3.81E+01	3.02E+01				mg/kg	2	2
Surface Water	Background Ravine	2,4,5-T				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		2,4-D				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		2,4-DB				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Acenaphthene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Acenaphthylene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0

d:\mary\ftsher2\surplou\drftfin1\bchtravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 25

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Background Ravine										
		Acetone				5.00E-03	9.00E-03	6.45E-03	mg/L	5	0
		Aldrin				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Aluminum	1.62E-01	1.03E+00	5.25E-01	2.00E-02	2.00E-02	2.00E-02	mg/L	5	3
		Amino-2,6-dinitrotoluene, 4-				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Amino-4,6-dinitrotoluene, 2-	1.26E-04	1.26E-04	1.26E-04	1.00E-03	1.00E-03	1.00E-03	mg/L	5	1
		Anthracene				2.50E-02	2.50E-02	2.50E-02	mg/L	5	0
		Antimony				1.25E-03	1.25E-03	1.25E-03	mg/L	6	2
		Arsenic	2.60E-03	2.70E-03	2.65E-03	1.00E-03	1.00E-03	1.00E-03	mg/L	5	5
		Barium	5.00E-02	6.62E-02	5.73E-02	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benz(a)anthracene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzo(a)pyrene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzo(b)fluoranthene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzo(ghi)perylene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzo(k)fluoranthene				1.00E-02	1.00E-02	1.00E-02	mg/L	5	0
		Benzoic acid				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Benzyl alcohol				2.50E-03	2.50E-03	2.50E-03	mg/L	5	0
		Beryllium				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bis(2-chloroethoxy) methane				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bis(2-chloroethyl) ether				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bis(2-chloroisopropyl) ether				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bis(2-ethylhexyl) phthalate				1.40E-03	1.47E-02	5.41E-03	mg/L	5	0
		Bromodichloromethane				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bromoforn				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bromomethane				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Bromophenyl phenyl ether, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Butylbenzyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Cadmium				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Calcium	8.64E+01	1.01E+02	9.22E+01	2.50E-03	2.50E-03	2.50E-03	mg/L	5	5
		Carbazole				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Carbon disulfide				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Carbon tetrachloride				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chlordane, alpha-				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Chlordane, gamma-				2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Chlordane, total				1.50E-05	1.50E-05	1.50E-05	mg/L	5	0
		Chloro-3-methylphenol, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chloroaniline, 4-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chlorobenzene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chloroethane				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Chloroethylvinyl ether, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chloroform				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chloromethane				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chloronaphthalene, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chlorophenol, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chlorophenyl phenyl ether, 4-				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Chromium, total				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Chrysene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Cobalt				1.00E-02	1.00E-02	1.00E-02	mg/L	5	0
		Copper				2.50E-03	2.50E-03	2.50E-03	mg/L	5	0
		DDD, p,p'-	1.10E-05	1.10E-05	1.10E-05	2.50E-06	2.50E-06	2.50E-06	mg/L	5	1
		DDE, p,p'-				3.50E-06	3.50E-06	3.50E-06	mg/L	5	0
		DDT, p,p'-				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Dalapon				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Di-n-butyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Di-n-octyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dibenz(ah)anthracene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dibenzofuran				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dibromochloromethane				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Dicamba				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichlorobenzene, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0

d:\mary\ftsher2\surplou\drftfinl\chrvs\dataum\ecodaum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 26

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Background Ravine	Dichlorobenzene, 1,3-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichlorobenzene, 1,4-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichlorobenzidine, 3,3'-	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Dichloroethane, 1,1-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloroethane, 1,2-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloroethene, 1,1-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloroethene, 1,2-, total	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichlorophenol, 2,4-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloropropane, 1,2-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloropropene, 1,3-, cis-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dichloropropene, 1,3-, trans-	.	.	.	5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Dieldrin	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Diethyl phthalate	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dimethyl phthalate	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Dimethylphenol, 2,4-	.	.	.	1.00E-02	1.00E-02	1.00E-02	mg/L	5	0
		Dinitro-2-methylphenol, 4,6-	.	.	.	5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Dinitrobenzene, 1,3-	.	.	.	1.50E-02	1.50E-02	1.50E-02	mg/L	5	0
		Dinitrophenol, 2,4-	.	.	.	3.00E-05	3.00E-05	3.00E-05	mg/L	5	0
		Dinitrotoluene, 2,4-	.	.	.	3.50E-05	3.50E-05	3.50E-05	mg/L	5	0
		Dinitrotoluene, 2,6-	.	.	.	2.87E-03	2.87E-03	2.76E-03	mg/L	5	2
		Dinitrotoluene, 3,4-	5.40E-03	5.78E-03	5.59E-03	3.50E-05	3.50E-05	3.50E-05	mg/L	5	0
		Dinoseb	.	.	.	5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Endosulfan A	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Endosulfan B	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Endosulfan sulfate	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Endrin	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Endrin aldehyde	.	.	.	1.00E-05	1.00E-05	1.00E-05	mg/L	5	0
		Endrin ketone	.	.	.	3.00E-06	3.00E-06	3.00E-06	mg/L	5	0
		Ethylbenzene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Fluoranthene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Fluorene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		HMX	.	.	.	1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		Heptachlor	5.80E-06	5.80E-06	5.80E-06	2.50E-06	2.50E-06	2.50E-06	mg/L	5	1
		Heptachlor epoxide	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Hexachlorobenzene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Hexachlorobutadiene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Hexachlorocyclohexane, alpha-	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Hexachlorocyclohexane, beta-	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Hexachlorocyclohexane, delta-	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Hexachlorocyclohexane, gamma-	.	.	.	2.50E-06	2.50E-06	2.50E-06	mg/L	5	0
		Hexachlorocyclopentadiene	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Hexachloroethane	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Indeno(1,2,3-cd)pyrene	2.21E-01	1.22E+00	6.65E-01	1.00E-03	1.00E-03	1.00E-03	mg/L	5	3
		Iron	.	.	.	2.25E-02	2.25E-02	2.25E-02	mg/L	5	0
		Isophorone	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Lead	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		MCPA	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		MCPP	.	.	.	1.50E-03	1.50E-03	1.50E-03	mg/L	5	0
		Magnesium	4.99E+01	6.38E+01	5.45E+01	.	.	.	mg/L	5	5
		Manganese	2.31E-02	2.18E-01	8.36E-02	2.50E-03	2.50E-03	2.50E-03	mg/L	5	4
		Mercury	.	.	.	1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		Methoxychlor	.	.	.	4.50E-06	4.50E-06	4.50E-06	mg/L	5	0
		Methyl ethyl ketone	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Methyl isobutyl ketone	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Methyl n-butyl ketone	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Methylene chloride	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Methylnaphthalene, 2-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Methylphenol, 2-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Methylphenol, 4-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Naphthalene	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Nickel	.	.	.	7.50E-03	7.50E-03	7.50E-03	mg/L	5	0
		Nitroaniline, 2-	.	.	.	5.00E-03	5.00E-03	5.00E-03	mg/L	5	0

d:\mary\ftsher2\surplisou\drftfinl\bchravs\datasum\ecodasum.lst



Appendix B2. Ecological Risk Assessment Data Summary  
Port Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 27

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Background Ravine	Nitroaniline, 3-				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Nitroaniline, 4-				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Nitrobenzene				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Nitrophenol, 2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Nitrophenol, 4-				1.00E-02	1.00E-02	1.00E-02	mg/L	5	0
		Nitrosodi-N-propylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Nitrosodiphenylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Nitrotoluene, 2-				1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		Nitrotoluene, 3-				1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		Nitrotoluene, 4-				1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		PCB 1016				1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		PCB 1221				1.00E-04	1.00E-04	1.00E-04	mg/L	5	0
		PCB 1232				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		PCB 1242				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		PCB 1248				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		PCB 1254				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		PCB 1260				6.50E-05	6.50E-05	6.50E-05	mg/L	5	0
		Pentachlorophenol				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Petroleum hydrocarbons, total (TPH)	1.82E-01	1.82E-01	1.82E-01	8.40E-02	8.40E-02	8.40E-02	mg/L	5	1
		Phenanthrene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Phenol				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Potassium	3.31E+00	4.56E+00	3.69E+00				mg/L	5	5
		Pyrene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		RDX	2.57E-04	2.57E-04	2.57E-04	1.00E-04	1.00E-04	1.00E-04	mg/L	5	1
		Selenium				1.25E-03	1.25E-03	1.25E-03	mg/L	5	0
		Silver				2.50E-03	2.50E-03	2.50E-03	mg/L	5	0
		Silvex (2,4,5-Tp)				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Sodium	2.47E+01	5.56E+01	4.12E+01				mg/L	5	5
		Styrene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Tetrachloroethane, 1,1,2,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Tetrachloroethene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Tetryl				5.00E-04	5.00E-04	5.00E-04	mg/L	5	0
		Thallium				1.25E-03	1.25E-03	1.25E-03	mg/L	5	0
		Toluene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Toxaphene				3.00E-04	3.00E-04	3.00E-04	mg/L	5	0
		Trichlorobenzene, 1,2,4-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Trichloroethane, 1,1,1-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Trichloroethane, 1,1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Trichloroethene				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Trichlorophenol, 2,4,5-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Trichlorophenol, 2,4,6-				1.00E-03	1.00E-03	1.00E-03	mg/L	5	0
		Trinitrobenzene, 1,3,5-				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Trinitrotoluene, 2,4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	5	0
		Vanadium	4.25E-04	4.25E-04	4.25E-04	5.00E-03	5.00E-03	5.00E-03	mg/L	5	1
		Vinyl acetate				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Vinyl chloride				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Xylenes, total				5.00E-03	5.00E-03	5.00E-03	mg/L	5	0
		Zinc				1.00E-02	1.00E-02	1.00E-02	mg/L	5	0
Surface Water	Beach	2,4-D				4.01E-04	4.01E-04	4.01E-04	mg/L	1	0
		Acenaphthene				8.50E-04	8.50E-04	8.50E-04	mg/L	4	0
		Acenaphthylene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Acetone				6.50E-03	6.50E-03	6.50E-03	mg/L	4	0
		Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/L	4	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/L	4	0
		Aldrin				4.59E-05	4.59E-05	4.59E-05	mg/L	4	0
		Aluminum				7.05E-02	7.05E-02	7.05E-02	mg/L	4	0
		Anthracene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Antimony				1.90E-02	1.90E-02	1.90E-02	mg/L	4	0
		Arsenic				1.27E-03	1.27E-03	1.27E-03	mg/L	4	0

d:\mary\fisher2\surpl\ou\drftfin\bcbravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 28

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Beach										
		Barium	2.44E-02	4.20E-02	3.53E-02				mg/L	4	4
		Benz(a)anthracene				8.00E-04	8.00E-04	8.00E-04	mg/L	4	0
		Benzene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Benzo(a)pyrene				5.00E-03	5.00E-03	5.00E-03	mg/L	4	0
		Benzo(b)fluoranthene				2.35E-03	2.35E-03	2.35E-03	mg/L	4	0
		Benzo(ghi)perylene				2.70E-03	2.70E-03	2.70E-03	mg/L	4	0
		Benzo(k)fluoranthene				3.05E-03	3.05E-03	3.05E-03	mg/L	4	0
		Benzoic acid				4.35E-04	4.35E-04	4.35E-04	mg/L	4	0
		Benzyl alcohol				6.50E-03	6.50E-03	6.50E-03	mg/L	4	0
		Beryllium				3.60E-04	3.60E-04	3.60E-04	mg/L	4	0
		Bis(2-chloroethoxy) methane				2.50E-03	2.50E-03	2.50E-03	mg/L	4	0
		Bis(2-chloroethyl) ether				7.50E-04	7.50E-04	7.50E-04	mg/L	4	0
		Bis(2-chloroisopropyl) ether				9.50E-04	9.50E-04	9.50E-04	mg/L	4	0
		Bis(2-ethylhexyl) phthalate				2.65E-03	2.65E-03	2.65E-03	mg/L	4	0
		Bromodichloromethane				2.40E-03	2.40E-03	2.40E-03	mg/L	4	0
		Bromoform				2.95E-04	2.95E-04	2.95E-04	mg/L	4	0
		Bromomethane				1.30E-03	1.30E-03	1.30E-03	mg/L	4	0
		Bromophenyl phenyl ether, 4-				2.90E-03	2.90E-03	2.90E-03	mg/L	4	0
		Butylbenzyl phthalate				2.10E-03	2.10E-03	2.10E-03	mg/L	4	0
		Cadmium				1.70E-03	1.70E-03	1.70E-03	mg/L	4	0
		Calcium	8.80E+01	1.30E+02	1.07E+02	2.01E-03	2.01E-03	2.01E-03	mg/L	4	4
		Carbon disulfide				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Carbon tetrachloride				2.90E-04	2.90E-04	2.90E-04	mg/L	4	0
		Chlordane, alpha-				2.55E-03	2.55E-03	2.55E-03	mg/L	4	0
		Chlordane, gamma-				2.55E-03	2.55E-03	2.55E-03	mg/L	4	0
		Chlordane, total				1.33E-04	1.33E-04	1.33E-04	mg/L	1	0
		Chloride							mg/L	4	4
		Chloro-3-methylphenol, 4-	1.91E+01	1.20E+02	7.73E+01				mg/L	4	0
		Chloroaniline, 4-				2.00E-03	2.00E-03	2.00E-03	mg/L	4	0
		Chlorobenzene				3.65E-03	3.65E-03	3.65E-03	mg/L	4	0
		Chloroethane				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Chloroethylvinyl ether, 2-				9.50E-04	9.50E-04	9.50E-04	mg/L	4	0
		Chloroform	1.60E-03	1.60E-03	1.60E-03	3.55E-04	3.55E-04	3.55E-04	mg/L	4	0
		Chloromethane				2.50E-04	2.50E-04	2.50E-04	mg/L	4	1
		Chloronaphthalene, 2-				1.60E-03	1.60E-03	1.60E-03	mg/L	4	0
		Chlorophenol, 2-				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Chlorophenyl phenyl ether, 4-				4.95E-04	4.95E-04	4.95E-04	mg/L	4	0
		Chromium, total				2.55E-03	2.55E-03	2.55E-03	mg/L	4	0
		Chrysene				3.01E-03	3.01E-03	3.01E-03	mg/L	4	0
		Cobalt				1.20E-03	1.20E-03	1.20E-03	mg/L	4	0
		Copper				1.25E-02	1.25E-02	1.25E-02	mg/L	4	0
		Cyanide, total				4.05E-03	4.05E-03	4.05E-03	mg/L	4	0
		DDD, p,p'-				1.25E-03	1.25E-03	1.25E-03	mg/L	4	0
		DDE, p,p'-				2.00E-03	2.00E-03	2.00E-03	mg/L	4	0
		DDT, p,p'-				2.35E-03	2.35E-03	2.35E-03	mg/L	4	0
		Di-n-butyl phthalate				1.70E-05	1.70E-05	1.70E-05	mg/L	4	0
		Di-n-octyl phthalate				1.85E-03	1.85E-03	1.85E-03	mg/L	4	0
		Dibenz(ah)anthracene				7.50E-03	7.50E-03	7.50E-03	mg/L	4	0
		Dibenzofuran				3.25E-03	3.25E-03	3.25E-03	mg/L	4	0
		Dibromochloromethane				8.50E-04	8.50E-04	8.50E-04	mg/L	4	0
		Dichlorobenzene, 1,2-				3.35E-04	3.35E-04	3.35E-04	mg/L	4	0
		Dichlorobenzene, 1,3-				8.50E-04	8.50E-04	8.50E-04	mg/L	4	0
		Dichlorobenzene, 1,4-				8.50E-04	8.50E-04	8.50E-04	mg/L	4	0
		Dichlorobenzenes, total				5.00E-03	5.00E-03	5.00E-03	mg/L	4	0
		Dichlorobenzidine, 3,3'-				6.00E-03	6.00E-03	6.00E-03	mg/L	4	0
		Dichloroethane, 1,1-				3.40E-04	3.40E-04	3.40E-04	mg/L	4	0
		Dichloroethane, 1,2-				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Dichloroethene, 1,1-				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Dichloroethenes, 1,2-, total				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0

d:\mary\ftsher2\surplou\drftfin\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Port Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 29

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Beach										
		Dichlorophenol, 2,4-				1.45E-03	1.45E-03	1.45E-03	mg/L	4	0
		Dichloropropane, 1,2-				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Dichloropropene, 1,3-, cis-				2.90E-04	2.90E-04	2.90E-04	mg/L	4	0
		Dichloropropene, 1,3-, trans-				3.50E-04	3.50E-04	3.50E-04	mg/L	4	0
		Dieldrin				1.20E-05	2.35E-03	1.77E-03	mg/L	4	0
		Diethyl phthalate				1.00E-03	1.00E-03	1.00E-03	mg/L	4	0
		Dimethyl phthalate				7.50E-04	7.50E-04	7.50E-04	mg/L	4	0
		Dimethylphenol, 2,4-				2.90E-03	2.90E-03	2.90E-03	mg/L	4	0
		Dinitro-2-methylphenol, 4,6-				8.50E-03	8.50E-03	8.50E-03	mg/L	4	0
		Dinitrobenzene, 1,3-				2.60E-04	2.60E-04	2.60E-04	mg/L	3	0
		Dinitrophenol, 2,4-				1.05E-02	1.05E-02	1.05E-02	mg/L	4	0
		Dinitrotoluene, 2,4-				3.06E-04	2.25E-03	7.92E-04	mg/L	4	0
		Dinitrotoluene, 2,6-				3.95E-04	3.95E-04	3.95E-04	mg/L	4	0
		Diphenylhydrazine, 1,2-				1.00E-03	1.00E-03	1.00E-03	mg/L	4	0
		Endosulfan A				1.15E-05	4.60E-03	3.45E-03	mg/L	4	0
		Endosulfan B				1.15E-05	4.60E-03	3.45E-03	mg/L	4	0
		Endosulfan sulfate				3.93E-05	4.60E-03	3.45E-03	mg/L	4	0
		Endrin				1.19E-05	3.80E-03	2.85E-03	mg/L	4	0
		Endrin aldehyde				1.43E-05	4.00E-03	3.00E-03	mg/L	4	0
		Endrin ketone				4.00E-03	4.00E-03	4.00E-03	mg/L	4	0
		Ethylbenzene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Fluoranthene				1.65E-03	1.65E-03	1.65E-03	mg/L	4	0
		Fluorene				1.85E-03	1.85E-03	1.85E-03	mg/L	4	0
		Fluoride				6.15E-01	6.15E-01	6.15E-01	mg/L	4	0
		HMX				8.25E-04	8.25E-04	8.25E-04	mg/L	3	0
		Heptachlor				2.12E-05	1.00E-03	7.55E-04	mg/L	4	0
		Heptachlor epoxide				1.23E-05	2.50E-03	1.88E-03	mg/L	4	0
		Hexachlorobenzene				8.00E-04	8.00E-04	8.00E-04	mg/L	4	0
		Hexachlorobutadiene				1.70E-03	1.70E-03	1.70E-03	mg/L	4	0
		Hexachlorocyclohexane, alpha-				1.93E-05	2.00E-03	1.50E-03	mg/L	4	0
		Hexachlorocyclohexane, beta-				1.20E-05	2.00E-03	1.50E-03	mg/L	4	0
		Hexachlorocyclohexane, delta-				1.47E-05	2.00E-03	1.50E-03	mg/L	4	0
		Hexachlorocyclohexane, gamma-				2.54E-05	2.00E-03	1.51E-03	mg/L	4	0
		Hexachlorocyclopentadiene				4.30E-03	4.30E-03	4.30E-03	mg/L	4	0
		Hexachloroethane				7.50E-04	7.50E-04	7.50E-04	mg/L	4	0
		Indeno(1,2,3-cd)pyrene				4.30E-03	4.30E-03	4.30E-03	mg/L	4	0
		Iron	9.66E-02	9.66E-02	9.66E-02	1.94E-02	1.94E-02	1.94E-02	mg/L	4	1
		Isodrin				2.81E-05	2.81E-05	2.81E-05	mg/L	1	0
		Isophorone				2.40E-03	2.40E-03	2.40E-03	mg/L	4	0
		Lead	1.41E-03	3.04E-03	2.23E-03	6.30E-04	6.30E-04	6.30E-04	mg/L	4	2
		Magnesium	4.60E+01	5.30E+01	4.95E+01				mg/L	4	4
		Manganese	6.68E-02	2.83E-01	1.67E-01				mg/L	4	4
		Mercury							mg/L	4	4
		Methoxychlor				1.22E-04	1.22E-04	1.22E-04	mg/L	4	0
		Methyl ethyl ketone				2.85E-05	2.85E-05	2.85E-05	mg/L	4	0
		Methyl isobutyl ketone				3.20E-03	3.20E-03	3.20E-03	mg/L	4	0
		Methyl n-butyl ketone				1.50E-03	1.50E-03	1.50E-03	mg/L	4	0
		Methylene chloride				1.80E-03	1.80E-03	1.80E-03	mg/L	4	0
		Methylnaphthalene, 2-				1.15E-03	1.15E-03	1.15E-03	mg/L	4	0
		Methylphenol, 2-				8.50E-04	8.50E-04	8.50E-04	mg/L	4	0
		Methylphenol, 4-				1.95E-03	1.95E-03	1.95E-03	mg/L	4	0
		Naphthalene				2.60E-04	2.60E-04	2.60E-04	mg/L	4	0
		Nickel				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Nitroaniline, 2-				1.72E-02	1.72E-02	1.72E-02	mg/L	4	0
		Nitroaniline, 3-				2.15E-03	2.15E-03	2.15E-03	mg/L	4	0
		Nitroaniline, 4-				2.45E-03	2.45E-03	2.45E-03	mg/L	4	0
		Nitrobenzene				2.60E-03	2.60E-03	2.60E-03	mg/L	4	0
		Nitrogen, NO2+NO3				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Nitrophenol, 2-	8.59E-02	7.80E-01	3.38E-01	5.00E-03	5.00E-03	5.00E-03	mg/L	4	3
		Nitrophenol, 4-				1.85E-03	1.85E-03	1.85E-03	mg/L	4	0
		Nitrosodi-N-propylamine, N-				6.00E-03	6.00E-03	6.00E-03	mg/L	4	0
		Nitrosodimethylamine, N-				2.20E-03	2.20E-03	2.20E-03	mg/L	4	0
		Nitrosodiphenylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	4	0
						1.50E-03	1.50E-03	1.50E-03	mg/L	4	0

d:\mary\ftsher2\surplusou\drftfinl\bchravs\datasum\scodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 30

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Beach	Organic carbon, total (TOC)	5.00E+00	1.12E+03	2.85E+02						
		PCB 1016				8.00E-05	1.05E-02	7.90E-03	mg/L	4	4
		PCB 1221				8.00E-05	1.05E-02	7.90E-03	mg/L	4	0
		PCB 1232				8.00E-05	1.05E-02	7.90E-03	mg/L	4	0
		PCB 1242				9.50E-05	1.50E-02	1.13E-02	mg/L	4	0
		PCB 1248				9.50E-05	1.50E-02	1.13E-02	mg/L	4	0
		PCB 1254				9.50E-05	1.50E-02	1.13E-02	mg/L	4	0
		PCB 1260				9.50E-05	1.50E-02	1.13E-02	mg/L	4	0
		Pentachlorophenol				9.50E-05	1.50E-02	1.13E-02	mg/L	4	0
		Phenanthrene				9.50E-05	1.50E-02	1.13E-02	mg/L	4	0
		Phenol				9.50E-05	1.50E-02	1.13E-02	mg/L	4	0
		Potassium	2.63E+00	4.04E+00	3.10E+00	2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Pyrene				4.60E-03	4.60E-03	4.60E-03	mg/L	4	0
		RDX				1.40E-03	1.40E-03	1.40E-03	mg/L	4	0
		Selenium				1.06E-03	1.06E-03	1.06E-03	mg/L	4	0
		Silver				1.51E-03	1.51E-03	1.51E-03	mg/L	4	0
		Silver (2,4,5-TP)				1.25E-04	1.25E-04	1.25E-04	mg/L	4	0
		Sodium	1.61E+01	5.09E+01	3.62E+01	8.50E-05	8.50E-05	8.50E-05	mg/L	1	0
		Styrene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Sulfate	8.89E+01	2.69E+02	1.57E+02				mg/L	4	4
		Tetrachloroethane, 1,1,2,2-				2.55E-04	2.55E-04	2.55E-04	mg/L	4	0
		Tetrachloroethene				8.00E-04	8.00E-04	8.00E-04	mg/L	4	0
		Tetryl				2.78E-04	2.78E-04	2.78E-04	mg/L	3	0
		Toluene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Toxaphene				6.75E-04	1.80E-02	1.37E-02	mg/L	4	0
		Trichlorobenzene, 1,2,4-				9.00E-04	9.00E-04	9.00E-04	mg/L	4	0
		Trichloroethane, 1,1,1-				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Trichloroethane, 1,1,2-				6.00E-04	6.00E-04	6.00E-04	mg/L	4	0
		Trichloroethene				2.50E-04	2.50E-04	2.50E-04	mg/L	4	0
		Trichlorofluoromethane				7.00E-04	7.00E-04	7.00E-04	mg/L	4	0
		Trichlorophenol, 2,4,5-				2.60E-03	2.60E-03	2.60E-03	mg/L	4	0
		Trichlorophenol, 2,4,6-				2.10E-03	2.10E-03	2.10E-03	mg/L	4	0
		Trinitrobenzene, 1,3,5-				3.13E-04	3.13E-04	3.13E-04	mg/L	3	0
		Trinitrotoluene, 2,4,6-				2.94E-04	2.94E-04	2.94E-04	mg/L	3	0
		Vanadium				1.91E-03	1.91E-03	1.91E-03	mg/L	4	0
		Vinyl acetate				4.15E-03	4.15E-03	4.15E-03	mg/L	4	0
		Vinyl chloride				1.30E-03	1.30E-03	1.30E-03	mg/L	4	0
		Xylenes, total				4.20E-04	4.20E-04	4.20E-04	mg/L	4	0
		Zinc				1.06E-02	1.06E-02	1.06E-02	mg/L	4	0
Surface Water	Hutchinson Ravine	2,4,5-T				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		2,4-D				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		2,4-DB				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Acenaphthene				8.50E-04	1.00E-03	9.89E-04	mg/L	14	0
		Acenaphthylene				2.50E-04	1.00E-03	9.46E-04	mg/L	14	0
		Acetone				5.00E-03	3.95E-02	1.01E-02	mg/L	7	0
		Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/L	1	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/L	1	0
		Aldrin	5.42E-02	2.36E+00	8.08E-01	2.50E-06	2.35E-03	1.98E-04	mg/L	12	0
		Aluminum				2.89E-02	8.90E-02	6.28E-02	mg/L	12	9
		Amino-2,6-dinitrotoluene, 4-				5.00E-05	5.00E-05	5.00E-05	mg/L	8	0
		Amino-4,6-dinitrotoluene, 2-				5.00E-05	5.00E-05	5.00E-05	mg/L	8	0
		Anthracene	1.36E-04	9.47E-04	4.30E-04	1.00E-05	1.00E-05	7.59E-04	mg/L	14	3
		Antimony	2.70E-03	2.70E-03	2.70E-03	1.90E-02	2.50E-02	2.45E-02	mg/L	12	0
		Arsenic	4.71E-02	1.08E-01	7.27E-02	1.25E-03	1.27E-03	1.25E-03	mg/L	12	1
		Barium							mg/L	12	12
		Benz(a)anthracene				1.00E-05	1.00E-03	6.32E-04	mg/L	14	0
		Benzene				2.50E-04	8.93E-04	7.90E-04	mg/L	7	0
		Benzidine				5.00E-03	5.00E-03	5.00E-03	mg/L	1	0
		Benzo(a)pyrene	1.47E-05	1.47E-05	1.47E-05	5.00E-06	2.35E-03	7.98E-04	mg/L	14	1

d:\mary\ftsher2\surplsum\drftfin\bchrras\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 31

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Hutchinson Ravine										
		Benzo(b)fluoranthene				5.00E-05	2.70E-03	7.82E-04	mg/L	14	0
		Benzo(g,h,i)perylene				5.00E-05	3.05E-03	8.07E-04	mg/L	14	0
		Benzo(k)fluoranthene	8.75E-06	8.75E-06	8.75E-06	5.00E-06	1.00E-03	6.50E-04	mg/L	14	1
		Benzoic acid				6.50E-03	1.00E-02	9.71E-03	mg/L	12	0
		Benzyl alcohol				3.60E-04	1.00E-03	9.47E-04	mg/L	12	0
		Beryllium				2.50E-03	2.50E-03	2.50E-03	mg/L	12	0
		Bis(2-chloroethoxy) methane				7.50E-04	1.00E-03	9.79E-04	mg/L	12	0
		Bis(2-chloroethyl) ether				9.50E-04	1.00E-03	9.96E-04	mg/L	12	0
		Bis(2-chloroisopropyl) ether				1.00E-03	2.65E-03	1.14E-03	mg/L	12	0
		Bis(2-ethylhexyl) phthalate	2.70E-03	1.40E-02	8.35E-03	1.00E-03	2.40E-03	1.14E-03	mg/L	12	2
		Boron	1.05E-01	1.70E-01	1.36E-01	8.50E-02	8.50E-02	8.50E-02	mg/L	8	7
		Bromodichloromethane				2.95E-04	1.00E-03	8.99E-04	mg/L	7	0
		Bromoform				1.00E-03	1.30E-03	1.04E-03	mg/L	7	0
		Bromomethane				1.00E-03	2.90E-03	1.27E-03	mg/L	7	0
		Bromophenyl phenyl ether, 4-				1.00E-03	2.10E-03	1.09E-03	mg/L	12	0
		Butylbenzyl phthalate	3.00E-03	3.00E-03	3.00E-03	1.00E-03	1.70E-03	1.06E-03	mg/L	12	1
		Cadmium				2.01E-03	2.50E-03	2.46E-03	mg/L	12	0
		Calcium	9.79E+01	1.51E+02	1.19E+02				mg/L	12	12
		Carbazole				1.00E-03	1.00E-03	1.00E-03	mg/L	11	0
		Carbon disulfide				2.50E-04	5.00E-03	4.32E-03	mg/L	7	0
		Carbon tetrachloride				2.90E-04	1.00E-03	8.99E-04	mg/L	7	0
		Chlordane, alpha-				2.50E-06	2.55E-03	2.15E-04	mg/L	12	0
		Chlordane, gamma-				2.50E-06	2.55E-03	2.15E-04	mg/L	12	0
		Chlordane, total				1.50E-05	1.50E-05	1.50E-05	mg/L	11	0
		Chloride	1.10E+02	1.00E+03	3.29E+02				mg/L	9	9
		Chloro-3-methylphenol, 4-				1.00E-03	2.00E-03	1.08E-03	mg/L	12	0
		Chloroaniline, 4-				1.00E-03	3.65E-03	1.22E-03	mg/L	12	0
		Chlorobenzene				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Chloroethane				9.50E-04	5.00E-03	4.42E-03	mg/L	7	0
		Chloroethylvinyl ether, 2-				3.55E-04	5.00E-03	4.34E-03	mg/L	7	0
		Chloroform				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Chloromethane	1.20E-02	1.20E-02	1.20E-02	1.00E-03	1.60E-03	1.10E-03	mg/L	7	1
		Chloronaphthalene, 2-				2.50E-04	1.00E-03	9.38E-04	mg/L	12	0
		Chlorophenol, 2-				4.95E-04	1.00E-03	9.58E-04	mg/L	12	0
		Chlorophenyl phenyl ether, 4-				1.00E-03	2.55E-03	1.13E-03	mg/L	12	0
		Chromium, total				3.01E-03	5.00E-03	4.83E-03	mg/L	12	0
		Chrysene				5.00E-05	1.20E-03	6.75E-04	mg/L	14	0
		Cobalt				1.00E-02	1.25E-02	1.02E-02	mg/L	12	0
		Copper				2.50E-03	4.05E-03	2.63E-03	mg/L	12	0
		Cyanide, total	5.33E-03	5.33E-03	5.33E-03	1.25E-03	1.25E-03	1.25E-03	mg/L	12	1
		DDD, P,p'-	3.50E-05	1.10E-04	7.17E-05	2.50E-06	2.00E-03	3.35E-04	mg/L	12	6
		DDG, P,p'-	1.20E-05	1.20E-05	1.20E-05	3.50E-06	2.35E-03	2.17E-04	mg/L	12	1
		DDT, P,p'-	7.10E-06	2.00E-05	1.30E-05	3.50E-06	4.60E-03	5.78E-04	mg/L	12	4
		Dalapon				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Decachlorobiphenyl	2.17E-04	3.30E-04	2.65E-04				mg/L	3	3
		Di-n-butyl phthalate				1.00E-03	1.85E-03	1.07E-03	mg/L	12	0
		Di-n-octyl phthalate				1.00E-03	7.50E-03	1.54E-03	mg/L	12	0
		Dibenz(ah)anthracene				2.50E-05	3.25E-03	8.13E-04	mg/L	14	0
		Dibenzofuran				8.50E-04	1.00E-03	9.88E-04	mg/L	12	0
		Dibromochloromethane				3.35E-04	1.00E-03	9.05E-04	mg/L	7	0
		Dicamba				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Dichlorobenzene, 1,2-				8.50E-04	1.00E-03	9.88E-04	mg/L	12	0
		Dichlorobenzene, 1,3-				8.50E-04	1.00E-03	9.88E-04	mg/L	12	0
		Dichlorobenzenes, total				8.50E-04	1.00E-03	9.88E-04	mg/L	12	0
		Dichlorobenzidine, 3,3'-				5.00E-03	5.00E-03	5.00E-03	mg/L	1	0
		Dichloroethane, 1,1-				5.00E-03	6.00E-03	5.08E-03	mg/L	12	0
		Dichloroethane, 1,2-				3.40E-04	1.00E-03	9.06E-04	mg/L	7	0
		Dichloroethene, 1,1-				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Dichloroethenes, 1,2-, total				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0

d:\mary\ftsher2\surplsum\drftfinl\bchraus\datausum\ecodasum.lst

d:\mary\ftsher2\surplsou\drftftfinl\bchravs\datasum\ecodasum.1st

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 33

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Hutchinson Ravine	Nitrophenol, 4-				6.00E-03	1.00E-02	9.67E-03	mg/L	12	0
		Nitrosodi-N-propylamine, N-				1.00E-03	2.20E-03	1.10E-03	mg/L	12	0
		Nitrosodimethylamine, N-				1.00E-03	1.00E-03	1.00E-03	mg/L	1	0
		Nitrosodiphenylamine, N-				1.00E-03	1.50E-03	1.04E-03	mg/L	12	0
		Nitrotoluene, 2-				1.00E-04	1.00E-04	1.00E-04	mg/L	8	0
		Nitrotoluene, 3-				1.00E-04	1.00E-04	1.00E-04	mg/L	8	0
		Nitrotoluene, 4-				1.00E-04	1.00E-04	1.00E-04	mg/L	8	0
		Organic carbon, total (TOC)	3.93E+00	8.00E+01	1.56E+01	5.00E-01	5.00E-01	5.00E-01	mg/L	9	8
		PCB 1016				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1221				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1232				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1242				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1248				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1254				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		PCB 1260				6.50E-05	1.05E-02	9.35E-04	mg/L	12	0
		Pentachlorophenol				5.00E-03	9.00E-03	5.33E-03	mg/L	12	0
		Phenanthrene				2.50E-04	1.00E-03	6.79E-04	mg/L	14	0
		Phenol				1.00E-03	4.60E-03	1.30E-03	mg/L	12	12
		Potassium	3.44E+00	8.86E+00	5.18E+00	5.00E-05	1.40E-03	7.38E-04	mg/L	14	1
		Pyrene	2.80E-04	2.80E-04	2.80E-04	1.00E-04	1.00E-04	1.00E-04	mg/L	8	0
		RDX				1.25E-03	1.51E-03	1.27E-03	mg/L	12	0
		Selenium				1.25E-04	2.50E-03	2.30E-03	mg/L	12	0
		Silver				5.00E-05	5.00E-05	5.00E-05	mg/L	6	0
		Silvex (2,4,5-TP)							mg/L	12	12
		Sodium	3.99E+01	5.40E+02	1.66E+02	2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Styrene							mg/L	9	9
		Sulfate	1.90E+01	2.00E+02	1.16E+02	2.55E-04	1.00E-03	8.94E-04	mg/L	7	0
		Tetrachloroethane, 1,1,2,2-				8.00E-04	1.00E-03	9.71E-04	mg/L	7	0
		Tetrachloroethene				5.00E-04	5.00E-04	5.00E-04	mg/L	8	0
		Tetryl				1.25E-03	1.25E-03	1.25E-03	mg/L	11	0
		Thallium				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Toluene				3.00E-04	1.80E-02	1.78E-03	mg/L	12	0
		Toxaphene				9.00E-04	1.00E-03	9.92E-04	mg/L	12	0
		Trichlorobenzene, 1,2,4-				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Trichloroethane, 1,1,1-				6.00E-04	1.00E-03	9.43E-04	mg/L	7	0
		Trichloroethane, 1,1,2-				2.50E-04	1.00E-03	8.93E-04	mg/L	7	0
		Trichloroethene				7.00E-04	7.00E-04	7.00E-04	mg/L	1	0
		Trichlorofluoromethane				1.00E-03	2.60E-03	1.13E-03	mg/L	12	0
		Trichlorophenol, 2,4,5-				1.00E-03	2.10E-03	1.09E-03	mg/L	12	0
		Trichlorophenol, 2,4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	8	0
		Trinitrobenzene, 1,3,5-				5.00E-05	5.00E-05	5.00E-05	mg/L	8	0
		Trinitrotoluene, 2,4,6-				1.91E-03	5.00E-03	4.74E-03	mg/L	12	0
		Vanadium				4.15E-03	5.00E-03	4.88E-03	mg/L	7	0
		Vinyl acetate				1.00E-03	1.30E-03	1.04E-03	mg/L	7	0
		Vinyl chloride				4.20E-04	5.00E-03	4.35E-03	mg/L	7	0
		Xylenes, total				1.00E-02	1.00E-02	1.00E-02	mg/L	12	2
		Zinc	2.01E-02	7.32E-02	4.67E-02				mg/L	1	1
Surface Water	Janes Extra	2,4-D	1.41E-03	1.41E-03	1.41E-03	8.50E-04	1.00E-03	9.50E-04	mg/L	3	0
		Acenaphthene				2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Acenaphthylene				5.00E-03	6.50E-03	5.75E-03	mg/L	3	1
		Acetone	1.40E-02	1.40E-02	1.40E-02	4.59E-05	4.59E-05	4.59E-05	mg/L	1	0
		Aldrin				7.05E-02	7.05E-02	7.05E-02	mg/L	3	2
		Aluminum	6.28E-02	2.04E+00	1.05E+00	5.00E-05	2.50E-04	1.17E-04	mg/L	3	0
		Anthracene				1.90E-02	2.50E-02	2.30E-02	mg/L	3	0
		Antimony				6.72E-03	1.25E-03	1.25E-03	mg/L	3	1
		Arsenic				1.55E-02	1.25E-02	1.25E-02	mg/L	3	2
		Barium				4.50E-02	8.00E-04	2.73E-04	mg/L	3	0
		Benz (a) anthracene				1.00E-05	1.00E-05	1.00E-05	mg/L	3	0
		Benzene				2.50E-04	1.00E-03	7.50E-04	mg/L	3	0

d:\mary\ftshera2\surplou\drftfinl\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 34

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Janes Extra										
		Benzo(a)pyrene	.	.	.	5.00E-06	2.35E-03	7.87E-04	mg/L	3	0
		Benzo(b)fluoranthene	.	.	.	5.00E-05	2.70E-03	9.33E-04	mg/L	3	0
		Benzo(ghi)perylene	.	.	.	5.00E-05	3.05E-03	1.05E-03	mg/L	3	0
		Benzo(k)fluoranthene	.	.	.	5.00E-06	4.35E-04	1.48E-04	mg/L	3	0
		Benzoic acid	.	.	.	6.50E-03	1.00E-02	8.83E-03	mg/L	3	0
		Benzyl alcohol	.	.	.	3.60E-04	1.00E-03	7.87E-04	mg/L	3	0
		Beryllium	.	.	.	2.50E-03	2.50E-03	2.50E-03	mg/L	3	0
		Bis(2-chloroethoxy) methane	.	.	.	7.50E-04	1.00E-03	9.17E-04	mg/L	3	0
		Bis(2-chloroethyl) ether	.	.	.	9.50E-04	1.00E-03	9.83E-04	mg/L	3	0
		Bis(2-chloroisopropyl) ether	.	.	.	1.00E-03	2.65E-03	1.55E-03	mg/L	3	0
		Bis(2-ethylhexyl) phthalate	.	.	.	1.00E-03	2.40E-03	1.47E-03	mg/L	3	0
		Bromodichloromethane	.	.	.	2.95E-04	1.00E-03	7.65E-04	mg/L	3	0
		Bromoforn	.	.	.	1.00E-03	1.30E-03	1.10E-03	mg/L	3	0
		Bromomethane	.	.	.	1.00E-03	2.90E-03	1.63E-03	mg/L	3	0
		Bromophenyl phenyl ether, 4-	.	.	.	1.00E-03	2.10E-03	1.37E-03	mg/L	3	0
		Butylbenzyl phthalate	.	.	.	1.00E-03	1.70E-03	1.23E-03	mg/L	3	0
		Cadmium	.	.	.	2.01E-03	2.50E-03	2.34E-03	mg/L	3	0
		Calcium	2.90E+01	7.19E+01	4.45E+01	.	.	.	mg/L	3	3
		Carbazole	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	2	0
		Carbon disulfide	.	.	.	2.50E-04	5.00E-03	3.42E-03	mg/L	3	0
		Carbon tetrachloride	.	.	.	2.90E-04	1.00E-03	7.63E-04	mg/L	3	0
		Chlordane, total	.	.	.	1.33E-04	1.33E-04	1.33E-04	mg/L	1	0
		Chloride	2.00E+01	2.00E+01	2.00E+01	.	.	.	mg/L	1	1
		Chloro-3-methylphenol, 4-	.	.	.	1.00E-03	2.00E-03	1.33E-03	mg/L	3	0
		Chloroaniline, 4-	.	.	.	1.00E-03	3.65E-03	1.88E-03	mg/L	3	0
		Chlorobenzene	.	.	.	2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Chloroethane	.	.	.	9.50E-04	5.00E-03	3.65E-03	mg/L	3	0
		Chloroethylvinyl ether, 2-	.	.	.	3.55E-04	5.00E-03	3.45E-03	mg/L	3	0
		Chloroform	.	.	.	2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Chloromethane	.	.	.	1.00E-03	1.60E-03	1.20E-03	mg/L	3	0
		Chloronaphthalene, 2-	.	.	.	2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Chlorophenol, 2-	.	.	.	4.95E-04	1.00E-03	8.32E-04	mg/L	3	0
		Chlorophenyl phenyl ether, 4-	.	.	.	1.00E-03	2.55E-03	1.52E-03	mg/L	3	0
		Chromium, total	.	.	.	3.01E-03	5.00E-03	4.34E-03	mg/L	3	0
		Chrysene	.	.	.	5.00E-05	1.20E-03	4.33E-04	mg/L	3	0
		Cobalt	.	.	.	1.00E-02	1.25E-02	1.08E-02	mg/L	3	0
		Copper	1.19E-02	1.19E-02	1.19E-02	2.50E-03	2.50E-03	2.50E-03	mg/L	3	1
		Cyanide, total	7.83E-05	7.83E-05	7.83E-05	1.25E-03	1.25E-03	1.25E-03	mg/L	1	0
		DDD, P,P'	.	.	.	1.35E-05	1.35E-05	1.35E-05	mg/L	1	0
		DDE, P,P'	1.05E-04	1.05E-04	1.05E-04	.	.	.	mg/L	1	1
		DDT, P,P'	.	.	.	1.00E-03	1.85E-03	1.28E-03	mg/L	3	0
		Di-n-butyl phthalate	.	.	.	1.00E-03	7.50E-03	3.17E-03	mg/L	3	0
		Di-n-octyl phthalate	.	.	.	2.50E-05	3.25E-03	1.10E-03	mg/L	3	0
		Dibenz(ah)anthracene	.	.	.	8.50E-04	1.00E-03	9.50E-04	mg/L	3	0
		Dibenzofuran	.	.	.	3.35E-04	1.00E-03	7.78E-04	mg/L	3	0
		Dibromochloromethane	.	.	.	8.50E-04	1.00E-03	9.50E-04	mg/L	3	0
		Dichlorobenzene, 1,2-	.	.	.	8.50E-04	1.00E-03	9.50E-04	mg/L	3	0
		Dichlorobenzene, 1,3-	.	.	.	8.50E-04	1.00E-03	9.50E-04	mg/L	3	0
		Dichlorobenzene, 1,4-	.	.	.	8.50E-04	1.00E-03	9.50E-04	mg/L	3	0
		Dichlorobenzidine, 3,3'	.	.	.	5.00E-03	6.00E-03	5.33E-03	mg/L	3	0
		Dichloroethane, 1,1-	.	.	.	3.40E-04	1.00E-03	7.80E-04	mg/L	3	0
		Dichloroethane, 1,2-	.	.	.	2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Dichloroethene, 1,1-	.	.	.	2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Dichloroethenes, 1,2-, total	.	.	.	2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Dichlorophenol, 2,4-	.	.	.	1.00E-03	1.45E-03	1.15E-03	mg/L	3	0
		Dichloropropane, 1,2-	.	.	.	2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Dichloropropene, 1,3-, cis-	.	.	.	2.90E-04	1.00E-03	7.63E-04	mg/L	3	0
		Dichloropropene, 1,3-, trans-	.	.	.	3.50E-04	1.00E-03	7.83E-04	mg/L	3	0
		Dieldrin	.	.	.	1.20E-05	1.20E-05	1.20E-05	mg/L	1	0
		Diethyl phthalate	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	3	0

d:\mary\ftsher2\surplisou\drftfin1\bchravs\datasum\ecodasum.lst



Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Janes Extra										
		Dimethyl phthalate				7.50E-04	1.00E-03	9.17E-04	mg/L	3	0
		Dimethylphenol, 2,4-				1.00E-03	2.90E-03	1.63E-03	mg/L	3	0
		Dinitro-2-methylphenol, 4,6-				8.50E-03	1.00E-02	9.50E-03	mg/L	3	0
		Dinitrophenol, 2,4-				1.00E-02	1.50E-02	1.35E-02	mg/L	3	0
		Dinitrotoluene, 2,4-				1.00E-03	2.25E-03	1.42E-03	mg/L	3	0
		Dinitrotoluene, 2,6-				3.95E-04	1.00E-03	7.98E-04	mg/L	3	0
		Endosulfan A				1.15E-05	1.15E-05	1.15E-05	mg/L	1	0
		Endosulfan B				1.15E-05	1.15E-05	1.15E-05	mg/L	1	0
		Endosulfan sulfate				3.93E-05	3.93E-05	3.93E-05	mg/L	1	0
		Endrin				1.19E-05	1.19E-05	1.19E-05	mg/L	1	0
		Endrin aldehyde				1.43E-05	1.43E-05	1.43E-05	mg/L	1	0
		Ethylbenzene				2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Fluoranthene				1.00E-05	1.65E-03	5.57E-04	mg/L	3	0
		Fluorene				2.50E-04	1.85E-03	7.83E-04	mg/L	3	0
		Heptachlor				6.15E-01	6.15E-01	6.15E-01	mg/L	1	0
		Heptachlor epoxide				2.12E-05	2.12E-05	2.12E-05	mg/L	1	0
		Hexachlorobenzene				1.23E-05	1.23E-05	1.23E-05	mg/L	1	0
		Hexachlorobutadiene				8.00E-04	1.00E-03	9.33E-04	mg/L	3	0
		Hexachlorocyclohexane, alpha-				1.00E-03	1.70E-03	1.23E-03	mg/L	3	0
		Hexachlorocyclohexane, beta-				1.93E-05	1.93E-05	1.93E-05	mg/L	1	0
		Hexachlorocyclohexane, delta-				1.20E-05	1.20E-05	1.20E-05	mg/L	1	0
		Hexachlorocyclohexane, gamma-				1.47E-05	1.47E-05	1.47E-05	mg/L	1	0
		Hexachlorocyclopentadiene				2.54E-05	2.54E-05	2.54E-05	mg/L	1	0
		Hexachloroethane				4.30E-03	5.00E-03	4.77E-03	mg/L	3	0
		Indeno (1,2,3-cd)pyrene				7.50E-04	1.00E-03	9.17E-04	mg/L	3	0
		Iron	4.72E-02	1.57E+00	6.37E-01	2.50E-05	4.30E-03	1.45E-03	mg/L	3	0
		Isodrin				2.81E-05	2.81E-05	2.81E-05	mg/L	1	0
		Isophorone				1.00E-03	2.40E-03	1.47E-03	mg/L	3	0
		Lead	1.84E-03	5.90E-03	3.87E-03	1.00E-03	1.00E-03	1.00E-03	mg/L	3	2
		Magnesium	9.89E+00	4.32E+01	2.25E+01	2.50E-03	2.50E-03	2.50E-03	mg/L	3	2
		Manganese	4.33E-02	1.61E-01	1.02E-01	1.00E-04	1.00E-04	1.00E-04	mg/L	2	1
		Mercury	3.17E-04	3.17E-04	3.17E-04	2.85E-05	2.85E-05	2.85E-05	mg/L	1	0
		Methoxychlor				3.20E-03	5.00E-03	4.40E-03	mg/L	3	0
		Methyl ethyl ketone				1.50E-03	5.00E-03	3.83E-03	mg/L	3	0
		Methyl isobutyl ketone				1.80E-03	5.00E-03	3.93E-03	mg/L	3	0
		Methyl n-butyl ketone				1.15E-03	5.00E-03	3.72E-03	mg/L	3	0
		Methylene chloride				1.00E-03	1.00E-03	1.00E-03	mg/L	2	0
		Methylnaphthalene, 1-				8.50E-04	1.00E-03	9.50E-04	mg/L	3	0
		Methylnaphthalene, 2-				1.00E-03	1.95E-03	1.32E-03	mg/L	3	0
		Methylphenol, 2-				2.60E-04	1.00E-03	7.53E-04	mg/L	3	0
		Methylphenol, 4-				2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Naphthalene				7.50E-03	1.72E-02	1.07E-02	mg/L	3	0
		Nickel				2.15E-03	5.00E-03	4.05E-03	mg/L	3	0
		Nitroaniline, 2-				2.45E-03	5.00E-03	4.15E-03	mg/L	3	0
		Nitroaniline, 3-				2.60E-03	5.00E-03	4.20E-03	mg/L	3	0
		Nitroaniline, 4-				2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Nitrobenzene				9.36E-02	9.36E-02	9.36E-02	mg/L	1	1
		Nitrogen, NO2+NO3				1.00E-03	1.85E-03	1.28E-03	mg/L	3	0
		Nitrophenol, 2-				6.00E-03	1.00E-02	8.67E-03	mg/L	3	0
		Nitrophenol, 4-				1.00E-03	2.20E-03	1.40E-03	mg/L	3	0
		Nitrosodi-N-propylamine, N-				1.00E-03	1.50E-03	1.17E-03	mg/L	3	0
		Nitrosodiphenylamine, N-				8.00E+00	8.00E+00	8.00E+00	mg/L	1	1
		Organic carbon, total (TOC)				8.00E-05	8.00E-05	8.00E-05	mg/L	1	0
		PCB 1016				9.50E-05	9.50E-05	9.50E-05	mg/L	1	0
		PCB 1260				5.00E-03	9.00E-03	6.33E-03	mg/L	3	0
		Pentachlorophenol				2.50E-04	2.50E-04	2.50E-04	mg/L	3	0
		Phenanthrene				1.00E-03	4.60E-03	2.20E-03	mg/L	3	0
		Phenol	1.14E+00	2.30E+01	9.32E+00	5.00E-05	1.40E-03	5.00E-04	mg/L	3	3
		Potassium				1.25E-03	1.51E-03	1.34E-03	mg/L	3	0
		Pyrene				1.25E-04	2.50E-03	1.71E-03	mg/L	3	0
		Selenium									
		Silver									

d:\mary\ftsher2\surplsou\drftfinl\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 36

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Janes Extra	Silvex (2,4,5-TP)				8.50E-05	8.50E-05	8.50E-05	mg/L	1	0
		Sodium	8.02E+00	2.67E+01	1.52E+01				mg/L	3	3
		Styrene				2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Sulfate	1.23E+01	1.23E+01	1.23E+01				mg/L	1	1
		Tetrachloroethane, 1,1,2,2-				2.55E-04	1.00E-03	7.52E-04	mg/L	3	0
		Tetrachloroethene				8.00E-04	1.00E-03	9.33E-04	mg/L	3	0
		Thallium				1.25E-03	1.25E-03	1.25E-03	mg/L	1	0
		Toluene	1.20E-03	1.20E-03	1.20E-03	1.00E-03	1.00E-03	1.00E-03	mg/L	3	1
		Toxaphene				6.75E-04	1.00E-03	6.75E-04	mg/L	1	0
		Trichlorobenzene, 1,2,4-				9.00E-04	1.00E-03	9.67E-04	mg/L	3	0
		Trichloroethane, 1,1,1-				2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Trichloroethane, 1,1,2-				6.00E-04	1.00E-03	8.67E-04	mg/L	3	0
		Trichloroethene				2.50E-04	1.00E-03	7.50E-04	mg/L	3	0
		Trichlorofluoromethane				7.00E-04	1.00E-03	7.00E-04	mg/L	1	0
		Trichlorophenol, 2,4,5-				1.00E-03	2.60E-03	1.53E-03	mg/L	3	0
		Trichlorophenol, 2,4,6-				1.00E-03	2.10E-03	1.37E-03	mg/L	3	0
		Triphenylene	3.96E-03	4.09E-03	4.03E-03				mg/L	2	2
		Vanadium				1.91E-03	5.00E-03	3.97E-03	mg/L	3	0
		Vinyl acetate				4.15E-03	5.00E-03	4.72E-03	mg/L	3	0
		Vinyl chloride				1.00E-03	1.30E-03	1.10E-03	mg/L	3	0
		Xylenes, total				4.20E-04	5.00E-03	3.47E-03	mg/L	3	0
		Zinc	1.78E-01	3.73E-01	2.76E-01	1.00E-02	1.00E-02	1.00E-02	mg/L	3	2
Surface Water	Janes Ravine	2,4-D				4.01E-04	4.01E-04	4.01E-04	mg/L	2	0
		Acenaphthene				8.50E-04	1.00E-03	9.50E-04	mg/L	6	0
		Acenaphthylene				2.50E-04	1.00E-03	7.50E-04	mg/L	6	0
		Acetone				5.00E-03	6.50E-03	6.00E-03	mg/L	3	0
		Acrolein				5.00E-02	5.00E-02	5.00E-02	mg/L	2	0
		Acrylonitrile				5.00E-02	5.00E-02	5.00E-02	mg/L	2	0
		Aldrin				2.50E-06	4.59E-05	1.70E-05	mg/L	6	0
		Aluminum	1.13E-01	5.40E+00	1.87E+00	7.05E-02	7.05E-02	7.05E-02	mg/L	6	4
		Amino-2,6-dinitrotoluene, 4-				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0
		Amino-4,6-dinitrotoluene, 2-				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0
		Anthracene				5.00E-05	5.00E-05	5.92E-04	mg/L	6	0
		Antimony				1.90E-02	2.50E-02	2.30E-02	mg/L	6	0
		Arsenic	2.70E-03	2.70E-03	2.70E-03	1.25E-03	1.27E-03	1.26E-03	mg/L	6	1
		Barium	2.58E-02	8.23E-02	5.77E-02				mg/L	6	6
		Benz(a)anthracene				1.00E-05	1.00E-03	7.68E-04	mg/L	6	0
		Benzene				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Benizidine				5.00E-03	5.00E-03	5.00E-03	mg/L	2	0
		Benzo(a)pyrene				5.00E-06	2.35E-03	1.28E-03	mg/L	6	0
		Benzo(b)fluoranthene				5.00E-05	2.70E-03	1.41E-03	mg/L	6	0
		Benzo(ghi)perylene				5.00E-05	3.05E-03	1.53E-03	mg/L	6	0
		Benzo(k)fluoranthene				5.00E-06	1.00E-03	6.46E-04	mg/L	6	0
		Benzoic acid				6.50E-03	1.00E-02	8.83E-03	mg/L	6	0
		Benzyl alcohol				3.60E-04	1.00E-03	7.87E-04	mg/L	6	0
		Beryllium				2.50E-03	2.50E-03	2.50E-03	mg/L	6	0
		Bis(2-chloroethoxy) methane				7.50E-04	1.00E-03	9.17E-04	mg/L	6	0
		Bis(2-chloroethyl) ether				9.50E-04	1.00E-03	9.83E-04	mg/L	6	0
		Bis(2-chloroisopropyl) ether				1.00E-03	2.65E-03	1.55E-03	mg/L	6	0
		Bis(2-ethylhexyl) phthalate				1.00E-03	2.40E-03	1.47E-03	mg/L	6	0
		Boron	1.14E-01	1.49E-01	1.32E-01				mg/L	4	4
		Bromodichloromethane				2.95E-04	1.00E-03	5.30E-04	mg/L	3	0
		Bromoform				1.00E-03	1.30E-03	1.20E-03	mg/L	3	0
		Bromomethane				1.00E-03	2.90E-03	2.27E-03	mg/L	3	0
		Bromophenyl phenyl ether, 4-				1.00E-03	2.10E-03	1.37E-03	mg/L	6	0
		Butylbenzyl phthalate	2.10E-03	2.10E-03	2.10E-03	1.00E-03	1.70E-03	1.28E-03	mg/L	6	1
		Cadmium	6.20E+01	1.11E+02	9.55E+01	2.01E-03	2.50E-03	2.34E-03	mg/L	6	0
		Calcium							mg/L	6	6
		Carbazole				1.00E-03	1.00E-03	1.00E-03	mg/L	4	0

d:\mary\ftsher2\surp1sou\drftfinl\bchra\datasum\ecodasum.lst

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Janes Ravine	Carbon disulfide				2.50E-04	5.00E-03	1.83E-03	mg/L	3	0
		Carbon tetrachloride				2.90E-04	1.00E-03	5.27E-04	mg/L	3	0
		Chlordane, alpha-				2.50E-06	2.55E-03	8.52E-04	mg/L	6	0
		Chlordane, gamma-				2.50E-06	2.55E-03	8.52E-04	mg/L	6	0
		Chlordane, total				1.50E-05	1.33E-04	5.42E-05	mg/L	6	0
		Chloride	6.30E+01	4.80E+02	1.59E+02				mg/L	6	6
		Chloro-3-methylphenol, 4-				1.00E-03	2.00E-03	1.33E-03	mg/L	6	0
		Chloroaniline, 4-				1.00E-03	3.65E-03	1.88E-03	mg/L	6	0
		Chlorobenzene				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Chloroethane				9.50E-04	5.00E-03	2.30E-03	mg/L	3	0
		Chloroethylvinyl ether, 2-				3.55E-04	5.00E-03	1.90E-03	mg/L	3	0
		Chloroform				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Chloromethane				1.00E-03	1.60E-03	1.40E-03	mg/L	3	0
		Chloronaphthalene, 2-				2.50E-04	1.00E-03	7.50E-04	mg/L	6	0
		Chlorophenol, 2-				4.95E-04	1.00E-03	8.32E-04	mg/L	6	0
		Chlorophenyl phenyl ether, 4-				1.00E-03	2.55E-03	1.52E-03	mg/L	6	0
		Chromium, total				3.01E-03	5.00E-03	4.34E-03	mg/L	6	0
		Chrysene				5.00E-05	1.20E-03	9.08E-04	mg/L	6	0
		Cobalt				1.00E-02	1.25E-02	1.08E-02	mg/L	6	0
		Copper	9.31E-03	9.31E-03	9.31E-03	2.50E-03	4.05E-03	3.12E-03	mg/L	6	1
		Cyanide, total				1.25E-03	1.25E-03	1.25E-03	mg/L	6	0
		DDD, P,p'-	6.20E-06	2.20E-05	1.41E-05	2.50E-06	1.17E-05	7.08E-06	mg/L	6	2
		DDG, P,p'-				3.50E-06	1.35E-05	6.83E-06	mg/L	6	0
		DDT, P,p'-	1.10E-05	1.10E-05	1.10E-05	3.50E-06	1.70E-05	8.90E-06	mg/L	6	1
		Di-n-butyl phthalate				1.00E-03	1.85E-03	1.28E-03	mg/L	6	0
		Di-n-octyl phthalate				1.00E-03	7.50E-03	3.17E-03	mg/L	6	0
		Dibenz(ah)anthracene				2.50E-05	3.45E-03	1.59E-03	mg/L	6	0
		Dibenzofuran				8.50E-04	1.00E-03	9.50E-04	mg/L	6	0
		Dibromochloromethane				3.35E-04	1.00E-03	5.57E-04	mg/L	3	0
		Dichlorobenzene, 1,2-				8.50E-04	1.00E-03	9.50E-04	mg/L	6	0
		Dichlorobenzene, 1,3-				8.50E-04	1.00E-03	9.50E-04	mg/L	6	0
		Dichlorobenzene, 1,4-				8.50E-04	1.00E-03	9.50E-04	mg/L	6	0
		Dichlorobenzenes, total				5.00E-03	6.00E-03	5.33E-03	mg/L	6	0
		Dichlorobenzidine, 3,3'-				3.40E-04	1.00E-03	5.60E-04	mg/L	3	0
		Dichloroethane, 1,1-				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Dichloroethane, 1,2-				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Dichloroethene, 1,1-				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Dichloroethenes, 1,2-, total				1.00E-03	1.45E-03	1.15E-03	mg/L	6	0
		Dichlorophenol, 2,4-				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Dichloropropane, 1,2-				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Dichloropropene, 1,3-, cis-				3.50E-04	1.00E-03	5.27E-04	mg/L	3	0
		Dichloropropene, 1,3-, trans-				2.50E-06	1.20E-05	5.67E-06	mg/L	6	0
		Dieldrin				1.00E-03	1.00E-03	1.00E-03	mg/L	6	0
		Diethyl phthalate				7.50E-04	1.00E-03	9.17E-04	mg/L	6	0
		Dimethyl phthalate				1.00E-03	2.90E-03	1.63E-03	mg/L	6	0
		Dinitrophenol, 2,4-				8.50E-03	1.00E-02	9.50E-03	mg/L	6	0
		Dinitro-2-methylphenol, 4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0
		Dinitrobenzene, 1,3-				1.05E-02	1.50E-02	1.35E-02	mg/L	6	0
		Dinitrophenol, 2,4-				3.00E-05	2.25E-03	9.32E-04	mg/L	6	0
		Dinitrotoluene, 2,4-				3.50E-05	1.00E-03	3.16E-04	mg/L	6	0
		Dinitrotoluene, 2,6-				1.00E-03	1.00E-03	1.00E-03	mg/L	2	0
		Diphenylhydrazine, 1,2-				2.50E-06	1.15E-05	5.50E-06	mg/L	6	0
		Endosulfan A				2.50E-06	1.15E-05	5.50E-06	mg/L	6	0
		Endosulfan B				2.50E-06	1.15E-05	5.50E-06	mg/L	6	0
		Endosulfan sulfate				2.50E-06	1.15E-05	5.50E-06	mg/L	6	0
		Endrin				2.50E-06	1.15E-05	5.50E-06	mg/L	6	0
		Endrin aldehyde				1.00E-05	1.43E-05	5.63E-06	mg/L	6	0
		Endrin ketone				1.00E-05	1.43E-05	5.63E-06	mg/L	6	0
		Ethylbenzene				3.00E-06	4.00E-03	1.34E-03	mg/L	6	0
		Fluoranthene				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
						1.00E-05	1.65E-03	1.05E-03	mg/L	6	0

d:\mary\fisher2\surpl\ou\drftfinl\bchra\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Janes Ravine	Fluorene	.	.	.	2.50E-04	1.85E-03	1.16E-03	mg/L	6	0
		Fluoride	.	.	.	2.50E-01	6.15E-01	3.72E-01	mg/L	6	0
		HMX	.	.	.	1.00E-04	1.00E-04	1.00E-04	mg/L	3	0
		Heptachlor	.	.	.	2.50E-06	2.12E-05	8.72E-06	mg/L	6	0
		Heptachlor epoxide	.	.	.	2.50E-06	1.23E-05	5.75E-06	mg/L	6	0
		Hexachlorobenzene	.	.	.	8.00E-04	1.00E-03	9.33E-04	mg/L	6	0
		Hexachlorobutadiene	.	.	.	1.00E-03	1.70E-03	1.23E-03	mg/L	6	0
		Hexachlorocyclohexane, alpha-	.	.	.	2.50E-06	1.93E-05	8.08E-06	mg/L	6	0
		Hexachlorocyclohexane, beta-	.	.	.	2.50E-06	1.20E-05	5.67E-06	mg/L	6	0
		Hexachlorocyclohexane, delta-	.	.	.	2.50E-06	1.47E-05	6.55E-06	mg/L	6	0
		Hexachlorocyclohexane, gamma-	.	.	.	2.50E-06	2.54E-05	1.16E-05	mg/L	6	1
		Hexachlorocyclopentadiene	.	.	.	4.30E-03	5.00E-03	4.77E-03	mg/L	6	0
		Hexachloroethane	.	.	.	7.50E-04	1.00E-03	9.17E-04	mg/L	6	0
		(Lindane)	.	.	.	2.50E-05	4.30E-03	1.94E-03	mg/L	6	0
		Indeno(1,2,3-cd)pyrene	1.86E-01	4.90E+00	1.59E+00	1.94E-02	1.94E-02	1.94E-02	mg/L	6	5
		Iron	.	.	.	2.81E-05	2.81E-05	2.81E-05	mg/L	2	0
		Isodrin	.	.	.	1.00E-03	2.40E-03	1.47E-03	mg/L	6	0
		Isophorone	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	6	4
		Lead	2.10E-03	6.50E-03	3.40E-03	.	.	.	mg/L	6	6
		Magnesium	3.50E+01	7.20E+01	6.02E+01	.	.	.	mg/L	6	6
		Manganese	1.13E-02	2.21E-01	1.38E-01	.	.	.	mg/L	6	6
		Mercury	.	.	.	1.00E-04	1.22E-04	1.07E-04	mg/L	6	0
		Methoxychlor	.	.	.	4.50E-06	2.85E-05	1.25E-05	mg/L	6	0
		Methyl ethyl ketone	.	.	.	3.20E-03	5.00E-03	3.80E-03	mg/L	3	0
		Methyl isobutyl ketone	.	.	.	1.50E-03	5.00E-03	2.67E-03	mg/L	3	0
		Methyl n-butyl ketone	.	.	.	1.80E-03	5.00E-03	2.87E-03	mg/L	3	0
		Methylene chloride	.	.	.	1.15E-03	5.00E-03	2.43E-03	mg/L	3	0
		Methylnaphthalene, 1-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	1	0
		Methylnaphthalene, 2-	.	.	.	8.50E-04	1.00E-03	9.50E-04	mg/L	6	0
		Methylphenol, 2-	.	.	.	1.00E-03	1.95E-03	1.32E-03	mg/L	6	0
		Methylphenol, 4-	.	.	.	2.60E-04	1.00E-03	7.53E-04	mg/L	6	0
		Naphthalene	.	.	.	2.50E-04	1.00E-03	7.50E-04	mg/L	6	0
		Nickel	.	.	.	7.50E-03	1.72E-02	1.07E-02	mg/L	6	0
		Nitroaniline, 2-	.	.	.	2.15E-03	5.00E-03	4.05E-03	mg/L	6	0
		Nitroaniline, 3-	.	.	.	2.45E-03	5.00E-03	4.15E-03	mg/L	6	0
		Nitroaniline, 4-	.	.	.	2.60E-03	5.00E-03	4.20E-03	mg/L	6	0
		Nitrobenzene	.	.	.	5.00E-05	1.00E-03	2.75E-04	mg/L	6	0
		Nitrogen, NO2+NO3	4.99E-02	6.60E-01	3.09E-01	.	.	.	mg/L	6	6
		Nitrophenol, 2-	.	.	.	1.00E-03	1.85E-03	1.28E-03	mg/L	6	0
		Nitrophenol, 4-	.	.	.	6.00E-03	1.00E-02	8.67E-03	mg/L	6	0
		Nitrosodi-N-propylamine, N-	.	.	.	1.00E-03	2.20E-03	1.40E-03	mg/L	6	0
		Nitrosodimethylamine, N-	.	.	.	1.00E-03	1.00E-03	1.00E-03	mg/L	2	0
		Nitrosodiphenylamine, N-	.	.	.	1.00E-03	1.50E-03	1.17E-03	mg/L	6	0
		Nitrotoluene, 2-	.	.	.	1.00E-04	1.00E-04	1.00E-04	mg/L	3	0
		Nitrotoluene, 3-	.	.	.	1.00E-04	1.00E-04	1.00E-04	mg/L	3	0
		Nitrotoluene, 4-	.	.	.	1.00E-04	1.00E-04	1.00E-04	mg/L	3	0
		Organic carbon, total (TOC)	2.00E+00	7.23E+00	3.74E+00	.	.	.	mg/L	6	6
		PCB 1016	.	.	.	6.50E-05	8.00E-05	7.00E-05	mg/L	6	0
		PCB 1221	.	.	.	6.50E-05	8.00E-05	7.00E-05	mg/L	6	0
		PCB 1232	.	.	.	6.50E-05	8.00E-05	7.00E-05	mg/L	6	0
		PCB 1242	.	.	.	6.50E-05	8.00E-05	7.00E-05	mg/L	6	0
		PCB 1248	.	.	.	6.50E-05	8.00E-05	7.00E-05	mg/L	6	0
		PCB 1254	.	.	.	6.50E-05	8.00E-05	7.00E-05	mg/L	6	0
		PCB 1260	.	.	.	6.50E-05	8.00E-05	7.00E-05	mg/L	6	0
		Pentachlorophenol	.	.	.	5.00E-03	9.00E-03	6.33E-03	mg/L	6	0
		Phenanthrene	.	.	.	2.50E-04	1.00E-03	6.25E-04	mg/L	6	0
		Phenol	.	.	.	1.00E-03	4.60E-03	2.20E-03	mg/L	6	0
		Potassium	2.12E+00	5.48E+00	3.33E+00	.	.	.	mg/L	6	6
		Pyrene	.	.	.	5.00E-05	1.40E-03	9.75E-04	mg/L	6	0
		RDX	.	.	.	1.00E-04	1.00E-04	1.00E-04	mg/L	3	0
		Selenium	.	.	.	1.25E-03	1.51E-03	1.34E-03	mg/L	6	0
		Silver	.	.	.	1.25E-04	2.50E-03	1.71E-03	mg/L	6	0
		Silver (2,4,5-TP)	.	.	.	8.50E-05	8.50E-05	8.50E-05	mg/L	2	0
		Sodium	2.95E+01	2.27E+02	7.14E+01	.	.	.	mg/L	6	6

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Surface Water	Janes Ravine	Styrene	5.31E+01	1.70E+02	1.27E+02	2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Sulfate							mg/L	6	6
		Tetrachloroethane, 1,1,2,2-				2.55E-04	1.00E-03	5.03E-04	mg/L	3	0
		Tetrachloroethene				8.00E-04	1.00E-03	8.67E-04	mg/L	3	0
		Tetryl				5.00E-04	1.00E-03	5.00E-04	mg/L	3	0
		Thallium				1.25E-03	1.25E-03	1.25E-03	mg/L	4	0
		Toluene				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Toxaphene				3.00E-04	6.75E-04	4.25E-04	mg/L	6	0
		Trichlorobenzene, 1,2,4-				9.00E-04	1.00E-03	9.67E-04	mg/L	6	0
		Trichloroethane, 1,1,1-				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Trichloroethane, 1,1,2-				6.00E-04	1.00E-03	7.33E-04	mg/L	3	0
		Trichloroethene				2.50E-04	1.00E-03	5.00E-04	mg/L	3	0
		Trichlorofluoromethane				7.00E-04	7.00E-04	7.00E-04	mg/L	2	0
		Trichlorophenol, 2,4,5-				1.00E-03	2.60E-03	1.53E-03	mg/L	6	0
		Trichlorophenol, 2,4,6-				1.00E-03	2.10E-03	1.37E-03	mg/L	6	0
		Trinitrobenzene, 1,3,5-				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0
		Trinitrotoluene, 2,4,6-				5.00E-05	5.00E-05	5.00E-05	mg/L	3	0
		Vanadium	1.13E-02	1.13E-02	1.13E-02	1.91E-03	5.00E-03	3.76E-03	mg/L	6	1
		Vinyl acetate				4.15E-03	5.00E-03	4.43E-03	mg/L	3	0
		Vinyl chloride				1.00E-03	1.30E-03	1.20E-03	mg/L	3	0
		Xylenes, total				4.20E-04	5.00E-03	1.95E-03	mg/L	3	0
		Zinc	2.38E-02	5.00E-02	3.69E-02	1.00E-02	1.06E-02	1.01E-02	mg/L	6	2
Worms	Background Beach	Acenaphthene				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Acenaphthylene				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Aldrin	1.70E-03	1.70E-03	1.70E-03				mg/kg	1	1
		Aluminum	1.16E+01	1.16E+01	1.16E+01				mg/kg	1	1
		Amino-2,6-dinitrotoluene, 4-				4.20E-02	4.20E-02	4.20E-02	mg/kg	1	0
		Amino-4,6-dinitrotoluene, 2-							mg/kg	1	1
		Anthracene	9.50E+01	9.50E+01	9.50E+01				mg/kg	1	0
		Antimony				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Arsenic	2.47E-01	2.47E-01	2.47E-01	1.22E-02	1.22E-02	1.22E-02	mg/kg	1	1
		Barium	1.77E+01	1.77E+01	1.77E+01				mg/kg	1	1
		Benz(a)anthracene				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Benzo(a)pyrene				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Benzo(b)fluoranthene				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Benzo(ghi)perylene				8.00E-01	8.00E-01	8.00E-01	mg/kg	1	0
		Benzo(k)fluoranthene				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Benzoic acid				7.00E+00	7.00E+00	7.00E+00	mg/kg	1	0
		Benzyl alcohol	1.80E+00	1.80E+00	1.80E+00				mg/kg	1	1
		Beryllium				4.88E-03	4.88E-03	4.88E-03	mg/kg	1	0
		Bis(2-chloroethoxy) methane				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Bis(2-chloroethyl) ether				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Bis(2-chloroisopropyl) ether				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Bis(2-ethylhexyl) phthalate				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Bromophenyl phenyl ether, 4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Butylbenzyl phthalate				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Cadmium	3.46E-02	3.46E-02	3.46E-02				mg/kg	1	1
		Calcium	3.94E+02	3.94E+02	3.94E+02				mg/kg	1	1
		Chlordane, alpha-	1.90E-03	1.90E-03	1.90E-03				mg/kg	1	1
		Chlordane, gamma-	6.30E-03	6.30E-03	6.30E-03				mg/kg	1	1
		Chloro-3-methylphenol, 4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Chloro-3-methylphenol, 4-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Chloro-3-methylphenol, 4-				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Chloronaphthalene, 2-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Chlorophenol, 2-				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Chlorophenyl phenyl ether, 4-				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Chromium, total	8.33E-02	8.33E-02	8.33E-02				mg/kg	1	1
		Chrysene	1.60E-01	1.60E-01	1.60E-01				mg/kg	1	0
		Cobalt	3.15E+00	3.15E+00	3.15E+00				mg/kg	1	1
		Copper							mg/kg	1	1

d:\mary\ftsher2\surplsol\drftfinl\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Worms	Background Beach	DOD, p,p'-	1.60E-02	1.60E-02	1.60E-02				mg/kg	1	1
		DDE, p,p'-	1.10E-02	1.10E-02	1.10E-02				mg/kg	1	1
		DDT, p,p'-	3.90E-03	3.90E-03	3.90E-03				mg/kg	1	1
		Di-n-butyl phthalate				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Di-n-octyl phthalate				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Dibenz(ah)anthracene				8.00E-01	8.00E-01	8.00E-01	mg/kg	1	0
		Dibenzofuran				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dichlorobenzene, 1,2-				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dichlorobenzene, 1,3-				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dichlorobenzene, 1,4-				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dichlorobenzidine, 3,3'-				2.50E+00	2.50E+00	2.50E+00	mg/kg	1	0
		Dichlorophenol, 2,4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Dieldrin				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Diethyl phthalate				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Dimethyl phthalate				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Dimethylphenol, 2,4-				3.50E-04	3.50E-04	3.50E-04	mg/kg	1	0
		Dinitro-2-methylphenol, 4,6-				5.00E+00	5.00E+00	5.00E+00	mg/kg	1	0
		Dinitrobenzene, 1,3-				4.00E-02	4.00E-02	4.00E-02	mg/kg	1	0
		Dinitrophenol, 2,4-				6.50E+00	6.50E+00	6.50E+00	mg/kg	1	0
		Endosulfan A				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Endosulfan B	1.20E-03	1.20E-03	1.20E-03				mg/kg	1	1
		Endosulfan sulfate				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Endrin				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Endrin aldehyde				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Fluoranthene				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Fluorene				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		HMX				8.00E-02	8.00E-02	8.00E-02	mg/kg	1	0
		Heptachlor				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Heptachlor epoxide				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorobutadiene				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorocyclohexane, alpha-				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorocyclohexane, beta-				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorocyclohexane, delta-				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorocyclohexane, gamma-				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorocyclopentadiene				5.00E+00	5.00E+00	5.00E+00	mg/kg	1	0
		Hexachloroethane				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Indeno(1,2,3-cd)pyrene				8.00E-01	8.00E-01	8.00E-01	mg/kg	1	0
		Iron	1.03E+02	1.03E+02	1.03E+02				mg/kg	1	1
		Isophorone				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Lead	2.51E-01	2.51E-01	2.51E-01				mg/kg	1	1
		Magnesium	1.50E+02	1.50E+02	1.50E+02				mg/kg	1	1
		Manganese	2.16E+00	2.16E+00	2.16E+00				mg/kg	1	1
		Mercury				4.88E-03	4.88E-03	4.88E-03	mg/kg	1	0
		Methoxychlor				1.85E-03	1.85E-03	1.85E-03	mg/kg	1	0
		Methylnaphthalene, 2-				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Methylphenol, 2-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Methylphenol, 4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Naphthalene				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Nickel	3.30E-01	3.30E-01	3.30E-01				mg/kg	1	1
		Nitroaniline, 2-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Nitroaniline, 3-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Nitroaniline, 4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Nitrophenol, 2-				2.50E+00	2.50E+00	2.50E+00	mg/kg	1	0
		Nitrophenol, 4-				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Nitrosodi-N-propylamine, N-				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Nitrosodiphenylamine, N-				7.50E-02	7.50E-02	7.50E-02	mg/kg	1	0
		Nitrotoluene, 2-				9.00E-02	9.00E-02	9.00E-02	mg/kg	1	0
		Nitrotoluene, 3-				9.00E-02	9.00E-02	9.00E-02	mg/kg	1	0
		Nitrotoluene, 4-				9.00E-02	9.00E-02	9.00E-02	mg/kg	1	0

d:\mary\ftsher2\surplsou\drftfin\bcbravs\datasum\ecodasum.1st

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Worms	Background Beach	PCB 1016				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1221				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1232				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1242				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1248				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1254				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1260				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		Pentachlorophenol				2.50E+00	2.50E+00	2.50E+00	mg/kg	1	0
		Phenanthrene				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Phenol				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Potassium	1.31E+03	1.31E+03	1.31E+03				mg/kg	1	1
		Pyrene				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		RDX	4.70E+00	4.70E+00	4.70E+00				mg/kg	1	1
		Selenium	3.84E-01	3.84E-01	3.84E-01				mg/kg	1	1
		Silver	6.81E-03	6.81E-03	6.81E-03				mg/kg	1	1
		Sodium	6.05E+02	6.05E+02	6.05E+02				mg/kg	1	1
		Tetryl				4.60E-02	4.60E-02	4.60E-02	mg/kg	1	0
		Thallium	9.33E-02	9.33E-02	9.33E-02				mg/kg	1	1
		Toxaphene				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		Trichlorobenzene, 1,2,4-				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Trichlorophenol, 2,4,5-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Trichlorophenol, 2,4,6-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Trinitrobenzene, 1,3,5-				3.90E-02	3.90E-02	3.90E-02	mg/kg	1	0
		Trinitrotoluene, 2,4,6-				4.35E-02	4.35E-02	4.35E-02	mg/kg	1	0
		Vanadium	5.55E-02	5.55E-02	5.55E-02				mg/kg	1	1
		Zinc	5.86E+01	5.86E+01	5.86E+01				mg/kg	1	1
Worms	Background Ravine	Amino-4,6-dinitrotoluene, 2-RDX	6.25E+01	6.25E+01	6.25E+01				mg/kg	1	1
		Acenaphthene				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Aldrin	1.40E-03	2.30E-03	1.85E-03				mg/kg	2	0
		Aluminum	1.39E+01	2.52E+01	1.96E+01				mg/kg	2	2
		Amino-2,6-dinitrotoluene, 4-Amino-4,6-dinitrotoluene, 2-Anthraccene	8.50E+01	1.02E+02	9.35E+01	4.20E-02	4.20E-02	4.20E-02	mg/kg	2	0
		Antimony				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Arsenic	2.51E-01	2.52E-01	2.52E-01	1.17E-02	1.25E-02	1.21E-02	mg/kg	2	0
		Barium	1.71E+01	1.91E+01	1.81E+01				mg/kg	2	2
		Benz(a)anthracene				5.00E-01	5.00E-01	5.00E-01	mg/kg	2	0
		Benzo(a)pyrene				7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
		Benzo(b)fluoranthene				5.00E-01	5.00E-01	5.00E-01	mg/kg	2	0
		Benzo(ghi)perylene				8.00E-01	8.00E-01	8.00E-01	mg/kg	2	0
		Benzo(k)fluoranthene				5.00E-01	5.00E-01	5.00E-01	mg/kg	2	0
		Benzoic acid				7.00E+00	7.00E+00	7.00E+00	mg/kg	2	0
		Benzyl alcohol	2.20E+00	2.40E+00	2.30E+00				mg/kg	2	2
		Beryllium				4.69E-03	4.99E-03	4.84E-03	mg/kg	2	0
		Bis(2-chloroethoxy) methane				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Bis(2-chloroethyl) ether				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Bis(2-chloroisopropyl) ether				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Bis(2-ethylhexyl) phthalate	1.10E+00	1.30E+00	1.20E+00				mg/kg	2	2
		Bromophenyl phenyl ether, 4-Butylbenzyl phthalate				7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
		Cadmium	3.36E-02	3.77E-02	3.57E-02	5.00E-01	5.00E-01	5.00E-01	mg/kg	2	0
		Calcium	4.17E+02	7.14E+02	5.66E+02				mg/kg	2	2
		Chlordane, alpha-Chlordane, gamma-Chlordane, gamma-Chloro-3-methylphenol, 4-Chloroaniline, 4-	2.00E-03	3.20E-03	2.60E-03				mg/kg	2	2
			5.40E-03	8.69E-03	7.05E-03				mg/kg	2	2
						7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
						1.50E+00	1.50E+00	1.50E+00	mg/kg	2	0

d:\mary\ftsher2\surplsou\drftin\bcbravs\data\sum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Port Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 42

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Worms	Beach	Chloronaphthalene, 2-				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Chlorophenol, 2-				7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
		Chlorophenyl phenyl ether, 4-				5.00E-01	5.00E-01	5.00E-01	mg/kg	2	0
		Chromium, total	8.52E-02	9.40E-02	8.96E-02				mg/kg	2	2
		Chrysene				5.00E-01	5.00E-01	5.00E-01	mg/kg	2	0
		Cobalt	1.89E-01	2.01E-01	1.95E-01				mg/kg	2	2
		Copper	3.29E+00	3.44E+00	3.37E+00				mg/kg	2	2
		DDT, p,p'-	1.90E-02	6.40E-02	4.15E-02				mg/kg	2	2
		DDE, p,p'-	1.00E-02	1.20E-02	1.10E-02				mg/kg	2	2
		DDT, p,p'-	3.30E-03	3.30E-03	3.30E-03				mg/kg	2	2
		Di-n-butyl phthalate				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	1
		Di-n-octyl phthalate				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Dibenz(ah)anthracene				7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
		Dibenzofuran				8.00E-01	8.00E-01	8.00E-01	mg/kg	2	0
		Dichlorobenzene, 1,2-				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Dichlorobenzene, 1,3-				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Dichlorobenzene, 1,4-				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Dichlorobenzidine, 3,3'-				2.50E+00	2.50E+00	2.50E+00	mg/kg	2	0
		Dichlorophenol, 2,4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
		Dieldrin				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Diethyl phthalate				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Dimethyl phthalate				5.00E-01	5.00E-01	5.00E-01	mg/kg	2	0
		Dimethylphenol, 2,4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
		Dinitro-2-methylphenol, 4,6-				5.00E+00	5.00E+00	5.00E+00	mg/kg	2	0
		Dinitrobenzene, 1,3-				4.00E-02	4.00E-02	4.00E-02	mg/kg	2	0
		Dinitrophenol, 2,4-				6.50E+00	6.50E+00	6.50E+00	mg/kg	2	0
		Endosulfan A				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Endosulfan B				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Endosulfan sulfate				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Endrin				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Endrin aldehyde				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Fluoranthene				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Fluorene				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		HMX				8.00E-02	8.00E-02	8.00E-02	mg/kg	2	0
		Heptachlor				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Heptachlor epoxide				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Hexachlorobenzene				5.00E-01	5.00E-01	5.00E-01	mg/kg	2	0
		Hexachlorobutadiene				7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
		Hexachlorocyclohexane, alpha-				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Hexachlorocyclohexane, beta-				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Hexachlorocyclohexane, delta-				3.35E-04	3.35E-04	3.35E-04	mg/kg	2	0
		Hexachlorocyclopentadiene, gamma-				5.00E+00	5.00E+00	5.00E+00	mg/kg	2	0
		Hexachlorocyclopentadiene				5.00E-01	5.00E-01	5.00E-01	mg/kg	2	0
		Hexachloroethane				8.00E-01	8.00E-01	8.00E-01	mg/kg	2	0
		Indeno(1,2,3-cd)pyrene							mg/kg	2	2
		Iron	9.84E+01	1.10E+02	1.04E+02				mg/kg	2	2
		Isophorone				7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
		Lead	2.30E-01	2.44E-01	2.47E-01				mg/kg	2	2
		Magnesium	1.31E+02	1.50E+02	1.41E+02				mg/kg	2	2
		Manganese	2.31E+00	2.69E+00	2.50E+00				mg/kg	2	2
		Mercury				4.69E-03	4.99E-03	4.84E-03	mg/kg	2	0
		Methoxychlor				5.00E-04	1.75E-03	1.13E-03	mg/kg	2	0
		Methylnaphthalene, 2-				5.00E-01	5.00E-01	5.00E-01	mg/kg	2	0
		Methylphenol, 2-				7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
		Methylphenol, 4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	2	0
		Naphthalene				3.50E-01	3.50E-01	3.50E-01	mg/kg	2	0
		Nickel	3.22E-01	4.80E-01	4.01E-01				mg/kg	2	2
		Nitroaniline, 2-				1.50E+00	1.50E+00	1.50E+00	mg/kg	2	0
		Nitroaniline, 3-				1.50E+00	1.50E+00	1.50E+00	mg/kg	2	0
		Nitroaniline, 4-				1.50E+00	1.50E+00	1.50E+00	mg/kg	2	0

d:\mary\fisher2\surplou\drftfinl\bchraus\datasum\ecodasum.1st



id: mary\ftsher2\surplsou\drftfinl\bchrravs\datasumm\ecodasum.1st

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BBA

12:02 Tuesday, March 3, 1998 44

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Worms	Hutchinson Ravine	Chlordane, alpha-Chlordane, gamma-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chloronaphthalene, 2-Chlorophenol, 2-Chlorophenyl phenyl ether, 4-Chromium, total	3.60E-03 5.50E-03	3.60E-03 5.50E-03	3.60E-03 5.50E-03				mg/kg	1	1
		Chrysene				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	1
		Cobalt	1.70E-01	1.70E-01	1.70E-01				mg/kg	1	1
		Copper	3.25E+00	3.25E+00	3.25E+00				mg/kg	1	1
		DDD, p,p'-	3.80E-01	3.80E-01	3.80E-01				mg/kg	1	1
		DDE, p,p'-	9.60E-02	9.60E-02	9.60E-02				mg/kg	1	1
		DDT, p,p'-	2.30E-03	2.30E-03	2.30E-03				mg/kg	1	1
		Di-n-butyl phthalate				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Di-n-octyl phthalate				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Dibenz(a,h)anthracene				8.00E-01	8.00E-01	8.00E-01	mg/kg	1	0
		Dibenzofuran				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzidine, 3,3'-Dichlorophenol, 2,4-Dieldrin				3.50E-01 7.00E-01 8.00E-01 3.50E-01 7.00E-01	3.50E-01 7.00E-01 8.00E-01 3.50E-01 7.00E-01	3.50E-01 7.00E-01 8.00E-01 3.50E-01 7.00E-01	mg/kg mg/kg mg/kg mg/kg mg/kg	1 1 1 1 1	0 0 0 0 0
		Diethyl phthalate				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dimethyl phthalate				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Dimethylphenol, 2,4-Dinitro-2-methylphenol, 4,6-Dinitrobenzene, 1,3-Dinitrophenol, 2,4-Endosulfan A				7.00E-01 7.00E-01 7.00E-01 7.00E-01	7.00E-01 7.00E-01 7.00E-01 7.00E-01	7.00E-01 7.00E-01 7.00E-01 7.00E-01	mg/kg mg/kg mg/kg mg/kg	1 1 1 1	0 0 0 0
		Endosulfan B				5.00E+00	5.00E+00	5.00E+00	mg/kg	1	0
		Endosulfan sulfate				4.00E-02	4.00E-02	4.00E-02	mg/kg	1	0
		Endrin				6.50E+00	6.50E+00	6.50E+00	mg/kg	1	0
		Endrin aldehyde				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Fluoranthene				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Fluorene				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		HMX				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Heptachlor				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Heptachlor epoxide				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorobenzene				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Hexachlorobutadiene				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Hexachlorocyclohexane, alpha-Hexachlorocyclohexane, beta-Hexachlorocyclohexane, delta-Hexachlorocyclohexane, gamma-Hexachlorocyclopentadiene				3.35E-04 3.35E-04 3.35E-04 3.35E-04 5.00E+00	3.35E-04 3.35E-04 3.35E-04 3.35E-04 5.00E+00	3.35E-04 3.35E-04 3.35E-04 3.35E-04 5.00E+00	mg/kg mg/kg mg/kg mg/kg mg/kg	1 1 1 1 1	0 0 0 0 0
		Hexachloroethane				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Indeno(1,2,3-cd)pyrene				8.00E-01	8.00E-01	8.00E-01	mg/kg	1	0
		Iron	1.14E+02	1.14E+02	1.14E+02				mg/kg	1	1
		Isophorone				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Lead	3.27E-01	3.27E-01	3.27E-01				mg/kg	1	1
		Magnesium	1.03E+02	1.03E+02	1.03E+02				mg/kg	1	1
		Manganese	2.41E+00	2.41E+00	2.41E+00				mg/kg	1	1
		Mercury	1.09E-02	1.09E-02	1.09E-02				mg/kg	1	1
		Methoxychlor				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Methylnaphthalene, 2-Methylphenol, 2-Methylphenol, 4-Naphthalene				5.00E-01 7.00E-01 7.00E-01 3.50E-01	5.00E-01 7.00E-01 7.00E-01 3.50E-01	5.00E-01 7.00E-01 7.00E-01 3.50E-01	mg/kg mg/kg mg/kg mg/kg	1 1 1 1	0 0 0 0

d:\mary\ftsher2\surplsou\drftfin\bchrravs\datasum\ecodasum.1st

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Worms	Hutchinson Ravine	Nickel	3.18E-01	3.18E-01	3.18E-01				mg/kg	1	1
		Nitroaniline, 2-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Nitroaniline, 3-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Nitroaniline, 4-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Nitrophenol, 2-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Nitrophenol, 4-				2.50E+00	2.50E+00	2.50E+00	mg/kg	1	0
		Nitrosodi-N-propylamine, N-				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Nitrosodiphenylamine, N-				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Nitrotoluene, 2-				7.50E-02	7.50E-02	7.50E-02	mg/kg	1	0
		Nitrotoluene, 3-				9.00E-02	9.00E-02	9.00E-02	mg/kg	1	0
		Nitrotoluene, 4-				9.00E-02	9.00E-02	9.00E-02	mg/kg	1	0
		PCB 1016				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1221				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1232				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1242				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1248				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1254				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1260				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		Pentachlorophenol				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		Phenanthrene				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		Phenol				2.50E+00	2.50E+00	2.50E+00	mg/kg	1	0
		Potassium	6.15E+02	6.15E+02	6.15E+02	3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Pyrene				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	1
		RDX				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Selenium	3.00E+00	3.00E+00	3.00E+00				mg/kg	1	1
		Silver	3.18E-01	3.18E-01	3.18E-01				mg/kg	1	1
		Sodium	1.17E-02	1.17E-02	1.17E-02				mg/kg	1	1
		Tetryl	2.12E+02	2.12E+02	2.12E+02				mg/kg	1	1
		Thallium	5.13E-02	5.13E-02	5.13E-02	4.60E-02	4.60E-02	4.60E-02	mg/kg	1	0
		Toxaphene							mg/kg	1	1
		Trichlorobenzene, 1,2,4-				1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		Trichlorophenol, 2,4,5-				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Trichlorophenol, 2,4,6-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Trinitrobenzene, 1,3,5-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Trinitrotoluene, 2,4,6-				3.90E-02	3.90E-02	3.90E-02	mg/kg	1	0
		Vanadium				4.35E-02	4.35E-02	4.35E-02	mg/kg	1	0
		Zinc	8.08E-02	8.08E-02	8.08E-02				mg/kg	1	1
			4.83E+01	4.83E+01	4.83E+01				mg/kg	1	1
Worms	Janes Ravine	Acenaphthene				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Acenaphthylene				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Aldrin	1.80E-03	1.80E-03	1.80E-03				mg/kg	1	1
		Aluminum	7.94E+01	7.94E+01	7.94E+01				mg/kg	1	1
		Amino-2,6-dinitrotoluene, 4-				4.20E-02	4.20E-02	4.20E-02	mg/kg	1	0
		Amino-4,6-dinitrotoluene, 2-							mg/kg	1	1
		Anthracene	5.50E+01	5.50E+01	5.50E+01				mg/kg	1	0
		Antimony				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Arsenic	3.48E-01	3.48E-01	3.48E-01	1.25E-02	1.25E-02	1.25E-02	mg/kg	1	0
		Barium	1.56E+01	1.56E+01	1.56E+01				mg/kg	1	1
		Benz(a)anthracene				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Benzo(a)pyrene				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Benzo(b)fluoranthene				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Benzo(ghi)perylene				8.00E-01	8.00E-01	8.00E-01	mg/kg	1	0
		Benzo(k)fluoranthene				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Benzoic acid				7.00E+00	7.00E+00	7.00E+00	mg/kg	1	0
		Benzyl alcohol				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Beryllium				4.98E-03	4.98E-03	4.98E-03	mg/kg	1	0
		Bis(2-chloroethoxy) methane				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Bis(2-chloroethyl) ether				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Bis(2-chloroisopropyl) ether				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Bis(2-ethylhexyl) phthalate				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0

d:\mary\fisher2\surplsou\drftfin\bchravs\datasum\ecodasum.lst

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 46

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Norms	Janes Ravine	Bromophenyl phenyl ether, 4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Butylbenzyl phthalate				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Cadmium	8.26E-02	8.26E-02	8.26E-02				mg/kg	1	1
		Calcium	5.58E+02	5.58E+02	5.58E+02				mg/kg	1	1
		Chlordane, alpha-	8.69E-03	8.69E-03	8.69E-03				mg/kg	1	1
		Chlordane, gamma-	9.20E-03	9.20E-03	9.20E-03				mg/kg	1	1
		Chloro-3-methylphenol, 4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Chloroaniline, 4-				1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Chloronaphthalene, 2-				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Chlorophenol, 2-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Chlorophenyl phenyl ether, 4-				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Chromium, total	2.17E-01	2.17E-01	2.17E-01				mg/kg	1	1
		Chrysene				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Cobalt	2.39E-01	2.39E-01	2.39E-01				mg/kg	1	1
		Copper	5.27E+00	5.27E+00	5.27E+00				mg/kg	1	1
		DDD, p,p'-	8.00E-02	8.00E-02	8.00E-02				mg/kg	1	1
		DDE, p,p'-	3.40E-02	3.40E-02	3.40E-02				mg/kg	1	1
		DDT, p,p'-	2.40E-03	2.40E-03	2.40E-03				mg/kg	1	1
		Di-n-butyl phthalate				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Di-n-octyl phthalate				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Dibenz(ah)anthracene				8.00E-01	8.00E-01	8.00E-01	mg/kg	1	0
		Dibenzofuran				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dichlorobenzene, 1,2-				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dichlorobenzene, 1,3-				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dichlorobenzene, 1,4-				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dichlorobenzidine, 3,3'-				2.50E+00	2.50E+00	2.50E+00	mg/kg	1	0
		Dichlorophenol, 2,4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Dieldrin				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Diethyl phthalate				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Dimethyl phthalate				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Dimethylphenol, 2,4-				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Dinitro-2-methylphenol, 4,6-				5.00E+00	5.00E+00	5.00E+00	mg/kg	1	0
		Dinitrobenzene, 1,3-				4.00E-02	4.00E-02	4.00E-02	mg/kg	1	0
		Dinitrophenol, 2,4-				6.50E+00	6.50E+00	6.50E+00	mg/kg	1	0
		Endosulfan A				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Endosulfan B				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Endosulfan sulfate				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Endrin				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Endrin aldehyde				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Fluoranthene				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Fluorene				8.00E-02	8.00E-02	8.00E-02	mg/kg	1	0
		HMX				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Heptachlor				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Heptachlor epoxide				3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Hexachlorobenzene				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Hexachlorobutadiene				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Hexachlorocyclohexane, alpha-				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorocyclohexane, beta-				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorocyclohexane, delta-				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorocyclohexane, gamma-				3.35E-04	3.35E-04	3.35E-04	mg/kg	1	0
		Hexachlorocyclopentadiene				5.00E+00	5.00E+00	5.00E+00	mg/kg	1	0
		Hexachloroethane				5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Indeno(1,2,3-cd)pyrene				8.00E-01	8.00E-01	8.00E-01	mg/kg	1	0
		Iron	1.71E+02	1.71E+02	1.71E+02				mg/kg	1	1
		Isophorone				7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Lead	3.76E-01	3.76E-01	3.76E-01				mg/kg	1	1
		Magnesium	1.47E+02	1.47E+02	1.47E+02				mg/kg	1	1
		Manganese	4.97E+00	4.97E+00	4.97E+00				mg/kg	1	1
		Mercury	1.49E-02	1.49E-02	1.49E-02				mg/kg	1	1
		Methoxychlor				1.55E-03	1.55E-03	1.55E-03	mg/kg	1	0

d:\mary\fisher2\surplou\drftfinl\bchtrav\datasumm\ecodasum.1st

Appendix B2. Ecological Risk Assessment Data Summary  
Fort Sheridan Surplus Operable Unit Beach/Ravines BRA

12:02 Tuesday, March 3, 1998 47

Medium	Study Area	Analyte	Min. Hit	Max. Hit	Mean Hit	Min. ND	Max. ND	Mean ND	Units	# of Records	# of Detects
Worms	Janes Ravine	Methylnaphthalene, 2-	.	.	.	5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Methylphenol, 2-	.	.	.	7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Methylphenol, 4-	.	.	.	7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Naphthalene	.	.	.	3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Nickel	1.19E+00	1.19E+00	1.19E+00	.	.	.	mg/kg	1	1
		Nitroaniline, 2-	.	.	.	1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Nitroaniline, 3-	.	.	.	1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Nitroaniline, 4-	.	.	.	1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Nitrophenol, 2-	.	.	.	7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Nitrophenol, 4-	.	.	.	2.50E+00	2.50E+00	2.50E+00	mg/kg	1	0
		Nitrosodi-N-propylamine, N-	.	.	.	5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Nitrosodiphenylamine, N-	.	.	.	3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Nitrotoluene, 2-	.	.	.	7.50E-02	7.50E-02	7.50E-02	mg/kg	1	0
		Nitrotoluene, 3-	.	.	.	9.00E-02	9.00E-02	9.00E-02	mg/kg	1	0
		Nitrotoluene, 4-	.	.	.	9.00E-02	9.00E-02	9.00E-02	mg/kg	1	0
		PCB 1016	.	.	.	1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1221	.	.	.	1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1232	.	.	.	1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1242	.	.	.	1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1248	.	.	.	1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1254	.	.	.	1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		PCB 1260	.	.	.	1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		Pentachlorophenol	.	.	.	2.50E+00	2.50E+00	2.50E+00	mg/kg	1	0
		Phenanthrene	.	.	.	3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		Phenol	.	.	.	7.00E-01	7.00E-01	7.00E-01	mg/kg	1	0
		Potassium	6.14E+02	6.14E+02	6.14E+02	.	.	.	mg/kg	1	1
		Pyrene	.	.	.	3.50E-01	3.50E-01	3.50E-01	mg/kg	1	0
		RDX	4.30E+00	4.30E+00	4.30E+00	.	.	.	mg/kg	1	1
		Selenium	2.86E-01	2.86E-01	2.86E-01	.	.	.	mg/kg	1	1
		Silver	1.03E-02	1.03E-02	1.03E-02	.	.	.	mg/kg	1	1
		Sodium	2.30E+02	2.30E+02	2.30E+02	.	.	.	mg/kg	1	1
		Tetryl	.	.	.	4.60E-02	4.60E-02	4.60E-02	mg/kg	1	0
		Thallium	3.76E-02	3.76E-02	3.76E-02	.	.	.	mg/kg	1	1
		Toxaphene	.	.	.	1.65E-02	1.65E-02	1.65E-02	mg/kg	1	0
		Trichlorobenzene, 1,2,4-	.	.	.	5.00E-01	5.00E-01	5.00E-01	mg/kg	1	0
		Trichlorophenol, 2,4,5-	.	.	.	1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Trichlorophenol, 2,4,6-	.	.	.	1.50E+00	1.50E+00	1.50E+00	mg/kg	1	0
		Trinitrobenzene, 1,3,5-	.	.	.	3.90E-02	3.90E-02	3.90E-02	mg/kg	1	0
		Trinitrotoluene, 2,4,6-	.	.	.	4.35E-02	4.35E-02	4.35E-02	mg/kg	1	0
		Vanadium	2.14E-01	2.14E-01	2.14E-01	.	.	.	mg/kg	1	1
		Zinc	4.46E+01	4.46E+01	4.46E+01	.	.	.	mg/kg	1	1

d:\mary\ftsher2\surplou\drftfinl\bchravs\datasum\ecodasum.lst  
c:\proj\sheridan\surplou\beachrav\hraz\append2\ecodasum.lst

## **Appendix C**

### **Background Comparison**

---

## **Appendix C.**

### **Example Calculations for Background-to-Study Area Inorganic Constituent Comparison**

---

Of the many possible outcomes presented in the flow chart in Figure 2-1, four basic examples cover the cases that occurred for the background-to-study area inorganic constituent comparison:

- (1) nonparametric due to unequal variances with study area concentrations significantly elevated above background concentrations (manganese in groundwater -- ecological risk assessment);
- (2) nonparametric due to the percent of nondetects exceeding 15 percent with study area concentrations not significantly elevated above background concentrations (aluminum in sediment -- human risk assessment);
- (3) nonparametric due to non-normality with study area concentrations not significantly elevated above background concentrations (aluminum in 0-1' soil -- ecological and human risk assessments);
- (4) lognormal with study area concentrations both significantly elevated and not elevated above background concentrations (sodium in surface water -- human risk assessment).

For the nonparametric cases, examples were provided both for when the study area concentrations were and were not significantly elevated above background concentrations. For the lognormal cases, an example was provided where the one study area concentration was significantly elevated above background concentrations and the other study area concentration was not significantly elevated above background concentrations. Additionally, no cases occurred where the normal distribution was appropriate for background and study area datasets.

Note that the datasets provided below represent data that have gone through flag/qualifier evaluation, blank evaluation, and field duplicate and multiple method evaluation. All data analyses were performed using the SAS® System. References for the various procedures are detailed in Section 2.3.1 (Background Comparison). Due to the complexity of some of the computations, SAS® output is provided for all four examples, and is supplemented with formulae and example calculations whenever feasible.

- (1) nonparametric due to unequal variances with study area concentrations significantly elevated above background concentrations (manganese in groundwater -- ecological risk assessment)

---

Groundwater Area	Manganese Concentration (mg/L)	Rank
Background	0.0293	4
	0.0391	6
	0.0405	7
	0.0563	9
	0.0607	11
	0.0826	13
	0.148	18
	0.185	21
	0.426	27



Groundwater Area	Manganese Concentration (mg/L)	Rank
LF2/SARN	0.0239	1
	0.026	2
	0.0261	3
	0.0384	5
	0.0431	8
	0.0603	10
	0.0727	12
	0.0941	14
	0.111	15
	0.117	16
	0.118	17
	0.176	19
	0.184	20
	0.196	22
	0.205	23
	0.212	34
	0.213	25
	0.36	26
	0.444	28
	0.5285	29
	0.53	30
	0.532	31
	0.6835	32
	0.712	33
	0.81	34
	0.939	35
	1.02	36
	1.11	37
	1.99	38
	2.14	39
	3.06	40
	3.68	41
	3.73	42
	4.05	43

The first step is to calculate the percent of nondetects (%ND), which for both the background and LF2/SARN is zero, since all data were quantified above the detection limit. As seen in the flow chart in Figure 2-1, since %ND<15, the data are then tested for lognormality using

the Shapiro-Wilk test on the natural logarithm-transformed data. Since the calculations for the Shapiro-Wilk test are computationally intensive, the reader is referred to Appendix H of the *Final Background Sampling and Data Evaluation Report* (ESE, 1997) for verifications of the SAS® output. The SAS® Univariate Procedure output for the Shapiro-Wilk test on the natural-logarithm transformed data follows:

Shapiro-Wilk Test to Check for Lognormality  
1. Manganese in Groundwater (mg/L) -- Ecological Risk Assessment  
SAS® Output

----- RAAREA=BKG -----											
UNIVARIATE PROCEDURE											
Variable=LNCONC											
Moments				Quantiles(Def=5)				Extremes			
N	9	Sum Wgts	9	100% Max	-0.85332	99%	-0.85332	Lowest	Obs	Highest	Obs
Mean	-2.51135	Sum	-22.6021	75% Q3	-1.91054	95%	-0.85332	-3.53017(	8)	-2.80181(	4)
Std Dev	0.870476	Variance	0.757729	50% Med	-2.80181	90%	-0.85332	-3.24163(	7)	-2.49375(	6)
Skewness	0.847452	Kurtosis	-0.01399	25% Q1	-3.20645	10%	-3.53017	-3.20645(	9)	-1.91054(	2)
USS	62.82364	CSS	6.061834	0% Min	-3.53017	5%	-3.53017	-2.87706(	5)	-1.6874(	1)
CV	-34.6617	Std Mean	0.290159			1%	-3.53017	-2.80181(	4)	-0.85332(	3)
T:Mean=0	-8.65508	Prob> T	0.0001	Range	2.676852						
Sgn Rank	-22.5	Prob> S	0.0039	Q3-Q1	1.29591						
Num ^= 0	9			Mode	-3.53017						
W:Normal	0.930013	Prob<W	0.4751								

----- RAAREA=LF2/SARN -----											
UNIVARIATE PROCEDURE											
Variable=LNCONC											
Moments				Quantiles(Def=5)				Extremes			
N	34	Sum Wgts	34	100% Max	1.398717	99%	1.398717	Lowest	Obs	Highest	Obs
Mean	-1.16091	Sum	-39.4711	75% Q3	-0.06294	95%	1.316408	-3.73388(	17)	0.760806(	2)
Std Dev	1.521165	Variance	2.313944	50% Med	-1.28406	90%	1.118415	-3.64966(	24)	1.118415(	18)
Skewness	0.016034	Kurtosis	-0.91627	25% Q1	-2.19823	10%	-3.2597	-3.64582(	16)	1.302913(	14)
JSS	122.1827	CSS	76.36015	0% Min	-3.73388	5%	-3.64966	-3.2597(	25)	1.316408(	26)
CV	-131.032	Std Mean	0.260878			1%	-3.73388	-3.14423(	32)	1.398717(	6)
T:Mean=0	-4.45003	Prob> T	0.0001	Range	5.132594						
Sgn Rank	-210.5	Prob> S	0.0001	Q3-Q1	2.135285						
Num ^= 0	34			Mode	-3.73388						
W:Normal	0.954874	Prob<W	0.2163								

The data are found to be lognormally distributed if the "Prob<W" value is greater than 0.05. For the background data (RAAREA=BKG), the "Prob<W" value is 0.4751, which is greater than 0.05. As the result, we can conclude that the background groundwater manganese data are lognormally distributed. Similarly, for the LF2/SARN data (RAAREA=LF2/SARN), the "Prob<W" value is 0.2163, which is also greater than 0.05. As a result, we can also conclude that the LF2/SARN groundwater manganese data are lognormally distributed. We cannot reject the null hypothesis that the data are lognormally distributed in favor of the alternate hypothesis that the data are not

---

lognormally distributed for either the background or LF2/SARN data for the ecological risk assessment.

Since the background and LF2/SARN data are lognormally distributed, we then tested for homogeneity of variances using Levene's test. This is done simply by performing a standard ANOVA on the absolute value of the residuals. The residuals are the individual values within a study area minus the mean value of the study area. The formula for the residuals is:

$$z_{ij} = | x_{ij} - \bar{x}_i |$$

where:  $z_{ij}$  = residual for the  $j^{\text{th}}$  analyte concentration from the  $i^{\text{th}}$  study area;

$x_{ij}$  = the natural logarithm of the  $j^{\text{th}}$  analyte concentration from the  $i^{\text{th}}$  study area; and

$\bar{x}_i$  = arithmetic average of the natural logarithm of the analyte concentrations at the  $i^{\text{th}}$  study area.

For example, the first of the nine residuals for the background is calculated as follows:

$$z_{BKG,1} = | \ln 0.0293 - (-2.51135) | = 1.02$$

The average value above of -2.51135 was taken from the SAS® Univariate Procedure output mean for RAAREA=BKG.

An example of the 34<sup>th</sup> of the 34 residuals for the LF2/SARN area follows.

$$z_{LF2/SARN,34} = | \ln 4.05 - (-1.16091) | = 2.56$$

A standard ANOVA was run on these residuals. Since the calculations for ANOVA are extremely complex, example calculations are not provided for this example, but are provided for the ANOVA on the natural logarithm-transformed data in example calculation #4. The procedure can be found in Section 5.2 of the EPA's *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities: Interim Final Guidance* (1989) or in many standard statistical textbooks. The SAS® General Linear Models Procedure output for Levene's test follows.

Levene's Test -- ANOVA on Residuals to Check for Homogeneity of Variances  
 1. Manganese in Groundwater (mg/L) -- Ecological Risk Assessment  
 SAS<sup>®</sup> Output

----- MEDIUM=GW CHEMNAME=Manganese FTBGS=All -----

General Linear Models Procedure

Class Levels Values  
 RAAREA 2 BKG LF2/SARN

Number of observations in by group = 43

Dependent Variable: RESID

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	2.46306061	2.46306061	4.45	0.0410
Error	41	22.67970898	0.55316363		
Corrected Total	42	25.14276960			

R-Square	C.V.	Root MSE	RESID Mean
0.097963	64.44103	0.74374971	1.15415546

Source	DF	Type I SS	Mean Square	F Value	Pr > F
RAAREA	1	2.46306061	2.46306061	4.45	0.0410

Source	DF	Type III SS	Mean Square	F Value	Pr > F
RAAREA	1	2.46306061	2.46306061	4.45	0.0410

Since the "Pr>F" of 0.0410 value is less than 0.05, we can reject the null hypothesis that the variances are equal in favor of the alternate hypothesis that the variances are not equal and can conclude that the variances are significantly different.

Although the %ND were less than 15 and the data were lognormally distributed, the variances were not homogeneous, so EPA recommends the application of the nonparametric ANOVA (also known as the Wilcoxon Rank Sum Test or Mann-Whitney U Test) in cases such as with the manganese groundwater data.

The large sample approximation for this procedure is performed as follows:

$$W = \sum_{j=1}^n R_j$$

where n = number of background samples = 9; and  
 R<sub>j</sub> = ranks assigned to the background concentrations.

From the table of ranks at the beginning of this example calculation,

$$W = 4 + 6 + 7 + 9 + 11 + 13 + 18 + 21 + 27 = 116$$

We then calculate  $W^*$  (not adjusted for ties) as:

$$W_{no\ ties}^* = \frac{W - \left[ \frac{n(m+n+1)}{2} \right]}{\sqrt{\frac{mn(m+n+1)}{12}}}$$

where:  $W$  = sum of ranks assigned to background = 116;

$n$  = number of background samples = 9; and

$m$  = number of Landfill 2 / Small Arms Range samples = 34.

Substituting these values, we obtain:

$$W_{no\ ties}^* = \frac{116 - \left[ \frac{9(34+9+1)}{2} \right]}{\sqrt{\frac{(34)(9)(34+9+1)}{12}}} = -2.4$$

Since  $-z_{\alpha}$  is -1.645, and -2.4 is less than -1.645, we can reject the null hypothesis that the background concentrations are not elevated above the LF2/SARN concentrations in favor of the alternate hypothesis that the background concentrations are elevated above the LF2/SARN concentrations.

The SAS® NPAR1WAY Procedure output follows and verifies the "hand calculations" above.

Nonparametric ANOVA a.k.a. Wilcoxon Rank Sum Test a.k.a. Mann-Whitney U Test  
1. Manganese in Groundwater (mg/L) -- Ecological Risk Assessment  
SAS® Output

#### N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable CONC  
Classified by Variable RAAREA

RAAREA	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
BKG	9	116.0	198.0	33.4962684	12.8888889
LF2/SARN	34	830.0	748.0	33.4962684	24.4117647

Wilcoxon 2-Sample Test (Normal Approximation)  
(with Continuity Correction of .5)

S= 116.000                      Z= -2.43311                      Prob > |Z| = 0.0150

T-Test approx. Significance = 0.0193

Kruskal-Wallis Test (Chi-Square Approximation)  
CHISQ= 5.9929                      DF= 1

Prob > CHISQ= 0.0144

Since the "Prob > |Z|" value of 0.0150 is less than 0.05, we can conclude that there is a significant difference between the BKG and LF2/SARN manganese concentrations. We reject the null hypothesis that the mean concentrations for background and LF2/SARN are equal in favor of the alternate hypothesis that the concentrations are different.

Multiple comparison procedures can confirm this difference. Since there were only two study areas, background and LF2/SARN, it is obvious where the difference exists. However, if there were a third study area, one would not know where the difference existed. The example below is provided to illustrate the technique. Dunn's approximation, which is not restricted to equal sample size cases, was used to verify the difference in concentrations. We decide that LF2/SARN concentrations are elevated above background if:

$$R_{LF2/SARN} - R_{BKG} \geq z_{(\alpha/(k-1))} \left[ \frac{N(N+1)}{12} \right]^{1/2} \left( \frac{1}{n_{LF2/SARN}} + \frac{1}{n_{BKG}} \right)^{1/2}$$

where  $R_{LF2/SARN}$  = average of the ranked concentrations for LF2/SARN = 24.4;

$R_{BKG}$  = average of the ranked concentrations for the background = 12.9;

$z_{(\alpha/(k-1))}$  = upper  $(\alpha/(k-1))$ -percentile from the standard normal distribution =  $z_{(0.05/(2-1))} = 1.645$ ;

$N$  = total sample size ( $n_{LF2/SARN} + n_{BKG}$ ) = 43;

$n_{LF2/SARN}$  = sample size for Landfill 2 / Small Arms Range = 34; and

$n_{BKG}$  = sample size for the background = 9.

Substituting the numbers for this comparison, we get

$$24.4 - 12.9 \geq 1.645 \left[ \frac{43(43+1)}{12} \right]^{1/2} \left( \frac{1}{34} + \frac{1}{9} \right)^{1/2}$$

Since  $11.5 \geq 7.74$ , we can reject the null hypothesis that the mean concentration for the background equals the mean concentration for the LF2/SARN study area in favor of the alternate hypothesis that the means are different. Since the LF2/SARN concentrations are elevated above background, the LF2/SARN data are carried forward in the ecological risk assessment.

- (2) nonparametric due to the percent of nondetects exceeding 15 percent with study area concentrations not significantly elevated above background concentrations (aluminum in sediment -- human risk assessment)**

The table below provides aluminum concentrations in sediment. If aluminum concentrations are below the detection limit, as indicated by a less than symbol (<), the concentration shown is one-half the detection limit. To the right of the concentration column is a column of ranks, upon which the nonparametric analyses are based. For instances where ties occurred (concentrations of <242.5 and <660 mg/kg), the average rank was used. For example, for the two <242.5 mg/kg concentrations, an average rank of 1½ was used  $[(1+2)/2=1½]$ . For the four <660 mg/kg concentrations, an average rank of 4½ was used  $[(3+4+5+6)/4=4½]$ . Duplicate samples were averaged prior to ranking [e.g. BGSD-2 and BGSD-2DUP (6,460 mg/kg and 6,400 mg/kg, respectively) were averaged to produce the concentration of 6,430 mg/kg].

Sediment Area	Aluminum Concentration (mg/kg)	Rank
Background Ravine	2,580	9
	3,670	12
	5,370	17
	6,430	20
	8,470	23
Hutchinson Ravine	<242.5	1½
	<660	4½
	<660	4½
	<660	4½
	3,510	11
	3,870	13
	4,410	15
	4,450	16
	5,470	18
	8,160	21
	9,100	25
Janes Ravine	<242.5	1½
	<660	4½
	2,070	7
	2,440	8
	2,950	10
	4,150	14
	6,400	19
	8,400	22
	9,040	24
	9,940	26
	12,500	27
	13,800	28

The first step is to calculate the percent of nondetects (%ND), which for both Hutchinson and Janes Ravines was greater than 15 percent (4/11=36.3 percent and 2/12=16.7 percent, respectively). The %ND for the background ravine was 0/5=0 percent, which is less than the cutoff level of 15 percent. As seen in the flow chart in Figure 2-1, since %ND $\geq$ 15 for any of the study areas (in this case two out of three study areas), the nonparametric ANOVA or Kruskal-Wallis Test is performed to determine if the aluminum sediment concentrations in Hutchinson and Janes Ravines are elevated above background ravine levels. Example calculations for the Kruskal-Wallis Test are provided below.

The sum of the ranks (referred to the "Sum of Scores" in the SAS® NPAR1WAY Procedure),  $R_j$ , is calculated as follows:

$$R_j = \sum_{i=1}^{n_j} r_{ij}$$

For the background ravine, the sum of the ranks is:

$$R_{BKGDRAY} = \sum_{i=1}^5 r_{i,BKGDRAY} = 9+12+17+20+23 = 81$$

The sums of the ranks are calculated similarly for Hutchinson and Janes Ravines and are 134 and 191, respectively.

The mean of the ranks (referred to the "Mean Score" in the SAS® NPAR1WAY Procedure),  $R_{.j}$ , is calculated as follows:

$$R_{.j} = \frac{R_j}{n_j}$$

For the background ravine, the mean of the ranks is:

$$R_{BKGDRAY} = \frac{81}{5} = 16.2$$

The means of the ranks are calculated similarly for Hutchinson and Janes Ravines and are 12.18 and 15.92, respectively.



The total sample size, N, is  $5 + 11 + 12 = 28$ .

Then, we compute the H statistic, which is:

$$H = \left( \frac{12}{N(N+1)} \sum_{j=1}^k \frac{R_j^2}{n_j} \right) - 3(N+1) =$$

$$\left[ \left( \frac{12}{28(28+1)} \right) \left( \frac{81^2}{5} + \frac{134^2}{11} + \frac{191^2}{12} \right) \right] - 3(28+1) = 1.443$$

Correcting for ties, we calculate H' as:

$$H' = \frac{H}{1 - \frac{\sum_{j=1}^g (t_j^3 - t_j)}{N^3 - N}}$$

where: H = large sample approximation test statistic calculated above = 1.443;

g = number of tied groups = 2;

t<sub>j</sub> = size of tied group j = 2 or 4; and

N = total sample size = 28.

Substituting the above values into the equation, we obtain:

$$H' = \frac{1.443}{1 - \frac{(2^3-2)+(4^3-4)}{28^3-28}} = 1.4474$$

This H' value of 1.4474 corresponds to the "CHISQ" value in the SAS® NPAR1WAY Procedure output. At the 0.05 level of significance, we reject the null hypothesis that the background ravine concentrations are equal to the Hutchinson and Janes Ravine concentrations if  $H \geq \chi^2_{(k-1, \alpha)}$ . With k=3 [k-1=2 degrees of freedom (df)] and  $\alpha=0.05$ , the corresponding chi-square value is approximately 6, which is not less than our H' value of 1.4474. As a result, we cannot reject the null hypothesis. The  $\alpha$ -value that corresponds to the calculated H value of 1.4474 is approximately 0.49, which is highly insignificant. This  $\alpha$ -value can be approximated using a chi-square table in many standard statistical

textbooks or can be more precisely determined using many software packages such as QuattroPro by entering @chidist(1.443,2). Note that the significance level of 0.49 corresponds to the "Prob > CHISQ" value of 0.4850 in the SAS® NPAR1WAY Procedure output.

The SAS® NPAR1WAY Procedure output follows.

Nonparametric ANOVA a.k.a. Kruskal-Wallis Test					
2. Aluminum in Sediment (mg/kg) -- Human Risk Assessment					
SAS® Output					
N P A R 1 W A Y P R O C E D U R E					
Wilcoxon Scores (Rank Sums) for Variable CONC					
Classified by Variable RAAREA					
RAAREA	N	Sum of	Expected	Std Dev	Mean
BKGDRAV	5	Scores	Under H0	Under H0	Score
		81.000000	72.5	16.6457210	16.2000000
HRAV	11	134.000000	159.5	21.2263095	12.1818182
JRAV	12	191.000000	174.0	21.5082118	15.9166667
Average Scores were used for Ties					
Kruskal-Wallis Test (Chi-Square Approximation)					
CHISQ= 1.4474		DF= 2		Prob > CHISQ= 0.4850	

Since the "Prob > CHISQ" value of 0.4850 is greater than 0.05, we can conclude that there is no significant difference between the background ravine (BKGDRAV), Hutchinson Ravine (HRAV), and Janes Ravine (JRAV) aluminum concentrations. We cannot reject the null hypothesis that the mean concentrations for the background ravine, Hutchinson Ravine, and Janes Ravine are equal in favor of the alternate hypothesis that the concentrations are different. A multiple comparison procedure was not performed since there were no significant differences among group means. Since the Hutchinson and Janes Ravine concentrations are not elevated above background ravine concentrations, the Hutchinson and Janes Ravine data are not carried forward in the human risk assessment.

**(3) nonparametric due to non-normality with study area concentrations not significantly elevated above background concentrations (aluminum in 0-1' soil -- human and ecological risk assessments)**

Aluminum concentrations in shallow soil (0-1') are provided below. If aluminum concentrations in soil are below the detection limit, as indicated by a less than symbol (<), the concentration shown is one-half the detection limit. To the right of the concentration column is a column of ranks, upon which the nonparametric analyses are based. For instances where ties occurred (concentrations of 9,100, 11,800, and 12,200 mg/kg), the average rank was used. For example, for the two 9,100 mg/kg concentrations, an average rank of 24½ was used [(24+25)/2=24½]. For the two 11,800 mg/kg

concentrations, an average rank of  $30\frac{1}{2}$  was used  $[(30+31)/2=30\frac{1}{2}]$ . Finally, for the three 12,200 mg/kg concentrations, an average rank of 35 was used  $[(34+35+36)/3=35]$ .

Soil (0-1') Area	Aluminum Concentration (mg/kg)	Rank
Background	<299.5	3
	4,870	7
	4,880	8
	6,900	10
	7,280	15
	7,660	16
	7,700	17
	7,860	18
	8,090	20
	8,180	21
	9,100	24½
	10,100	28
	11,800	30½
	11,900	32
	12,200	35
	12,600	37
LF2/SARN	<214	1
	<256	2
	<525	4
	660	5
	4,310	6
	6,300	9
	7,010	11
	7,140	12
	7,210	13
	7,220	14
	7,910	19
	8,500	22
	9,090	23
	9,100	24½
	9,420	26
	9,920	27
	11,400	29
	11,800	30½
	12,100	33
	12,200	35
	12,200	35
	13,100	38
	13,900	39

The first step is to calculate the percent of nondetects (%ND), which for both the background and LF2/SARN is less than 15 percent (1/16=6.25 percent and 3/23=13 percent, respectively). As seen in the flow chart in Figure 2-1, since %ND<15, the data are then tested for lognormality using the Shapiro-Wilk test on the natural logarithm-transformed data. Since the calculations for the Shapiro-Wilk test are computationally intensive, the reader is referred to Appendix H of the *Final Background Sampling and Data Evaluation Report* (ESE, 1997) for verifications of the SAS® output. The SAS® Univariate Procedure output for the Shapiro-Wilk test on the natural-logarithm transformed data follows:

Shapiro-Wilk Test to Check for Lognormality										
3. Aluminum in Soil (0-1') (mg/kg) -- Human and Ecological Risk Assessments										
SAS® Output										
----- RAAREA=BKG -----										
UNIVARIATE PROCEDURE										
Variable=LNCONC										
Moments										
N	16	Sum Wgts	16	100% Max	9.441452	99%	9.441452	Lowest	Obs	Highest
Mean	8.827203	Sum	141.2353	75% Q3	9.298073	95%	9.441452	5.702114(	4)	9.220291(
Std Dev	0.88212	Variance	0.778136	50% Med	8.983963	90%	9.409191	8.490849(	1)	9.375855(
Skewness	-3.29957	Kurtosis	12.06836	25% Q1	8.866081	10%	8.490849	8.4929(	3)	9.384294(
USS	1258.384	CSS	11.67204	0% Min	5.702114	5%	5.702114	8.839277(	2)	9.409191(
CV	9.993202	Std Mean	0.22053			1%	5.702114	8.892886(	5)	9.441452(
T:Mean=0	40.02721	Prob> T	0.0001	Range	3.739338					
Sgn Rank	68	Prob> S	0.0001	Q3-Q1	0.431991					
Num ^= 0	16			Mode	5.702114					
W:Normal	0.57315	Prob<W	0.0001							
----- RAAREA=LF2/SARN -----										
UNIVARIATE PROCEDURE										
Variable=LNCONC										
Moments										
N	23	Sum Wgts	23	100% Max	9.539644	99%	9.539644	Lowest	Obs	Highest
Mean	8.558449	Sum	196.8443	75% Q3	9.375855	95%	9.480368	5.365976(	22)	9.400961(
Std Dev	1.285053	Variance	1.651361	50% Med	9.047821	90%	9.409191	5.545177(	5)	9.409191(
Skewness	-1.76151	Kurtosis	1.733244	25% Q1	8.748305	10%	6.263398	6.263398(	4)	9.409191(
USS	1721.012	CSS	36.32995	0% Min	5.365976	5%	5.545177	6.49224(	1)	9.480368(
CV	15.01502	Std Mean	0.267952			1%	5.365976	8.368693(	16)	9.539644(
T:Mean=0	31.94022	Prob> T	0.0001	Range	4.173668					
Sgn Rank	138	Prob> S	0.0001	Q3-Q1	0.62755					
Num ^= 0	23			Mode	9.409191					
W:Normal	0.67578	Prob<W	0.0001							

The data are found to be lognormally distributed if the "Prob<W" value is greater than 0.05. For the background data (RAAREA=BKG), the "Prob<W" value is 0.0001, which is not greater than 0.05. As the result, we can conclude that the background 0-1' soil aluminum concentration data are not lognormally distributed. Similarly, for the LF2/SARN data (RAAREA=LF2/SARN), the "Prob<W" value is 0.0001, which is also not greater than 0.05. As a result, we can also conclude that the LF2/SARN 0-1' soil aluminum concentration data are not lognormally distributed. We can reject the

null hypothesis that the data are lognormally distributed in favor of the alternate hypothesis that the data are not lognormally distributed for either the background or LF2/SARN data.

Since the background and LF2/SARN data are not lognormally distributed, we then tested the data to see if they are normally distributed. For this test, we used the untransformed data (Variable=CONC) as opposed to the natural logarithm-transformed data (Variable=LNCONC). The SAS® Univariate Procedure output for the Shapiro-Wilk test on untransformed data follows:

Shapiro-Wilk Test to Check for Normality  
3. Aluminum in Soil (0-1') (mg/kg) -- Human and Ecological Risk Assessments  
SAS® Output

RAAREA=BKG											
UNIVARIATE PROCEDURE											
Variable=CONC											
Moments				Quantiles(Def=5)				Extremes			
N	16	Sum Wgts	16	100% Max	12600	99%	12600	Lowest	Obs	Highest	Obs
Mean	8213.719	Sum	131419.5	75% Q3	10950	95%	12600	299.5(	4)	10100(	12)
Std Dev	3205.852	Variance	10277486	50% Med	7975	90%	12200	4870(	1)	11800(	11)
Skewness	-0.7451	Kurtosis	1.159921	25% Q1	7090	10%	4870	4880(	3)	11900(	14)
USS	1.2336E9	CSS	1.5416E8	0% Min	299.5	5%	299.5	6900(	2)	12200(	15)
CV	39.03046	Std Mean	801.463			1%	299.5	7280(	5)	12600(	8)
T:Mean=0	10.24841	Prob> T	0.0001	Range	12300.5						
Sgn Rank	68	Prob> S	0.0001	Q3-Q1	3860						
Num = 0	16			Mode	299.5						
W:Normal	0.924133	Prob<W	0.1977								
RAAREA=LF2/SARN											
UNIVARIATE PROCEDURE											
Variable=CONC											
Moments				Quantiles(Def=5)				Extremes			
N	23	Sum Wgts	23	100% Max	13900	99%	13900	Lowest	Obs	Highest	Obs
Mean	7890.652	Sum	181485	75% Q3	11800	95%	13100	214(	22)	12100(	17)
Std Dev	4246.896	Variance	18036129	50% Med	8500	90%	12200	256(	5)	12200(	10)
Skewness	-0.65973	Kurtosis	-0.48659	25% Q1	6300	10%	525	525(	4)	12200(	12)
USS	1.8288E9	CSS	3.9679E8	0% Min	214	5%	256	660(	1)	13100(	7)
CV	53.82187	Std Mean	885.5391			1%	214	4310(	16)	13900(	15)
T:Mean=0	8.910563	Prob> T	0.0001	Range	13686						
Sgn Rank	138	Prob> S	0.0001	Q3-Q1	5500						
Num = 0	23			Mode	12200						
W:Normal	0.905305	Prob<W	0.0310								

Although the background data tested to be normally distributed ("Prob<W"=0.1977), the LF2/SARN data were not normally distributed ("Prob<W"=0.0310). Since the LF2/SARN data were neither normal nor lognormal, EPA recommends the application of the nonparametric ANOVA (also known as the Wilcoxon Rank Sum Test or Mann-Whitney U Test) in cases such as with the aluminum 0-1' soil data.

The large sample approximation for this procedure is performed as follows:

$$W = \sum_{j=1}^n R_j$$

where  $n$  = number of background samples = 9; and

$R_j$  = ranks assigned to the background concentrations.

From the table of ranks at the beginning of this example calculation,

$$W = 3+7+8+10+15+16+17+18+20+21+24.5+28+30.5+32+35+37 = 322$$

We then calculate  $W^*$  (adjusted for ties) as:

$$W_{ties}^* = \frac{W - \left[ \frac{n(m+n+1)}{2} \right]}{\sqrt{\frac{mn}{12} \left[ m+n+1 - \frac{\sum_{j=1}^g t_j(t_j^2-1)}{(m+n)(m+n-1)} \right]}}$$

where:  $W$  = sum of ranks assigned to background = 322;

$n$  = number of background samples = 16;

$m$  = number of Landfill 2 / Small Arms Range samples = 23;

$g$  = number of tied groups = 3;

$t_j$  = size of tied group  $j$  = 2 or 3.

Substituting these values, we obtain:

$$W_{ties}^* = \frac{322 - \left[ \frac{16(23+16+1)}{2} \right]}{\sqrt{\frac{(16)(23)}{12} \left[ 16+23+1 - \frac{2(2^2-1)+2(2^2-1)+3(3^2-1)}{(16+23)(16+23-1)} \right]}}} = 0.06$$

Since  $-z_{\alpha}$  is -1.645, and 0.06 is greater than -1.645, we cannot reject the null hypothesis that the background concentrations are not elevated above the LF2/SARN concentrations in favor of the

alternate hypothesis that the background concentrations are elevated above the LF2/SARN concentrations. This  $W_{ties}^*$  value of 0.06 is slightly different from the "Z" value provided in the SAS® NPAR1WAY Procedure output of 0.04. The cause of the slight difference in values may be due to methodology differences. Regardless of the slight difference, the outcome is the same in that the test is highly insignificant.

The SAS® NPAR1WAY Procedure output which corresponds with the "hand calculations" above follows.

Nonparametric ANOVA a.k.a. Wilcoxon Rank Sum Test a.k.a. Mann-Whitney U Test  
3. Aluminum in Soil (0-1') (mg/kg) -- Human and Ecological Risk Assessments  
SAS® Output

#### N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable CONC  
Classified by Variable RAAREA

RAAREA	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
BKG	16	322.0	320.0	35.0131651	20.1250000
LF2/SARN	23	458.0	460.0	35.0131651	19.9130435

Average Scores were used for Ties

Wilcoxon 2-Sample Test (Normal Approximation)  
(with Continuity Correction of .5)

S= 322.000                      Z= 0.042841                      Prob > |Z| = 0.9658

T-Test approx. Significance = 0.9661

Kruskal-Wallis Test (Chi-Square Approximation)  
CHISQ= 0.00326                      DF= 1

Prob > CHISQ= 0.9544

Since the "Prob > |Z|" value of 0.9658 is greater than 0.05, we can conclude that there is not a significant difference between the BKG and LF2/SARN aluminum concentrations. We cannot reject the null hypothesis that the mean concentrations for background and LF2/SARN are equal in favor of the alternate hypothesis that the concentrations are different.

Since there was no significant difference between background and LF2/SARN aluminum shallow soil concentrations, multiple comparison procedures were not performed and we concluded that the data should not be carried forward in the human or ecological risk assessments.

#### (4) lognormal with study area concentrations significantly elevated above background concentrations (sodium in surface water -- human risk assessment)

Surface Water Area	Sodium Concentration (mg/L)
Background Ravine	24.7
	29.0
	43.1
	53.4
	55.55
Hutchinson Ravine	39.9
	58.2
	58.3
	86.1
	92.0
	149
	177
	178
	195
	204
	220
	540
Janes Ravine	8.02
	10.9
	26.7
	29.5
	33.1
	34.4
	43.5
	61.0
	227

Note that duplicate data were averaged prior to performing any statistical analyses. For example background sample BGSW-1 and BGSW-1DUP with concentrations of 56.7 mg/L and 54.4 mg/L, respectively, were averaged to obtain the concentration of 55.55 mg/L.

The first step is to calculate the percent of nondetects (%ND), which for both the background ravine, Hutchinson Ravine, and Janes Ravine is 0, since all data were quantified above the detection limit. As seen in the flow chart in Figure 2-1, since %ND<15, the data are then tested for lognormality using the Shapiro-Wilk test on the natural logarithm-transformed data. Since the calculations for the Shapiro-Wilk test are computationally intensive, the reader is referred to Appendix H of the *Final Background Sampling and Data Evaluation Report* (ESE, 1997) for verifications of the SAS® output. The SAS® Univariate Procedure output for the Shapiro-Wilk test on the natural-logarithm transformed data follows:



Shapiro-Wilk Test to Check for Lognormality  
4. Sodium in Surface Water (mg/L) -- Human Risk Assessment  
SAS<sup>®</sup> Output

----- RAAREA=BKGDRAV -----

Univariate Procedure

Variable=LNCONC

Moments			Quantiles(Def=5)			Extremes					
N	5	Sum Wgts	5	100% Max	4.017284	99%	4.017284	Lowest	Obs	Highest	Obs
Mean	3.666543	Sum	18.33272	75% Q3	3.977811	95%	4.017284	3.206803(	3)	3.206803(	3)
Std Dev	0.364081	Variance	0.132555	50% Med	3.763523	90%	4.017284	3.367296(	4)	3.367296(	4)
Skewness	-0.42953	Kurtosis	-2.50073	25% Q1	3.367296	10%	3.206803	3.763523(	2)	3.763523(	2)
USS	67.74792	CSS	0.530221	0% Min	3.206803	5%	3.206803	3.977811(	5)	3.977811(	5)
CV	9.929828	Std Mean	0.162822			1%	3.206803	4.017284(	1)	4.017284(	1)
T:Mean=0	22.5187	Pr> T	0.0001	Range	0.81048						
Num ^= 0	5	Num > 0	5	Q3-Q1	0.610515						
M(Sign)	2.5	Pr>= M	0.0625	Mode	3.206803						
Sgn Rank	7.5	Pr>= S	0.0625								
W:Normal	0.887449	Pr<W	0.3421								

----- RAAREA=HRAV -----

Univariate Procedure

Variable=LNCONC

Moments			Quantiles(Def=5)			Extremes					
N	12	Sum Wgts	12	100% Max	6.291569	99%	6.291569	Lowest	Obs	Highest	Obs
Mean	4.86928	Sum	58.43136	75% Q3	5.29556	95%	6.291569	3.686376(	2)	5.181784(	8)
Std Dev	0.729759	Variance	0.532548	50% Med	5.090048	90%	5.393628	4.063885(	4)	5.273(	11)
Skewness	0.120674	Kurtosis	-0.09216	25% Q1	4.260556	10%	4.063885	4.065602(	3)	5.31812(	10)
USS	290.3767	CSS	5.858032	0% Min	3.686376	5%	3.686376	4.455509(	5)	5.393628(	1)
CV	14.987	Std Mean	0.210663			1%	3.686376	4.521789(	6)	6.291569(	9)
T:Mean=0	23.11404	Pr> T	0.0001	Range	2.605193						
Num ^= 0	12	Num > 0	12	Q3-Q1	1.035004						
M(Sign)	6	Pr>= M	0.0005	Mode	3.686376						
Sgn Rank	39	Pr>= S	0.0005								
W:Normal	0.949492	Pr<W	0.5837								

----- RAAREA=JRAV -----

Univariate Procedure

Variable=LNCONC

Moments			Quantiles(Def=5)				Extremes				
N	9	Sum Wgts	9	100% Max	99%	5.42495	Lowest	Obs	Highest	Obs	
Mean	3.498437	Sum	31.48593	75% Q3	3.772761	95%	5.42495	2.081938(	5)	3.499533(	8)
Std Dev	0.965654	Variance	0.932488	50% Med	3.499533	90%	5.42495	2.388763(	1)	3.538057(	7)
Skewness	0.5677	Kurtosis	1.424912	25% Q1	3.284664	10%	2.081938	3.284664(	2)	3.772761(	4)
USS	117.6114	CSS	7.459907	0% Min	2.081938	5%	2.081938	3.38439(	6)	4.110874(	3)
CV	27.60245	Std Mean	0.321885			1%	2.081938	3.499533(	8)	5.42495(	9)
T:Mean=0	10.8686	Pr> T	0.0001	Range	3.343012						
Num ^= 0	9	Num > 0	9	Q3-Q1	0.488097						
M(Sign)	4.5	Pr>= M	0.0039	Mode	2.081938						
Sgn Rank	22.5	Pr>= S	0.0039								
W:Normal	0.930534	Pr<W	0.4801								

The data are found to be lognormally distributed if the "Prob<W" value is greater than 0.05. For the background ravine data (RAAREA=BKGDRAV), the "Prob<W" value is 0.3421, which is greater than 0.05. As the result, we can conclude that the background ravine surface water sodium data are lognormally distributed. Similarly, for the Hutchinson Ravine data (RAAREA=HRAV), the "Prob<W" value is 0.5837, which is also greater than 0.05. As a result, we can also conclude that the Hutchinson Ravine surface water sodium data are lognormally distributed. For the Janes Ravine data

(RAAREA=JRAV), the "Prob<W" value is 0.4801, which is also greater than 0.05. As a result, we can also conclude that the Janes Ravine surface water sodium data are lognormally distributed. We cannot reject the null hypothesis that the data are lognormally distributed in favor of the alternate hypothesis that the data are not lognormally distributed for the background ravine, Hutchinson Ravine, or Janes Ravine data.

Since all three study area data sets are lognormally distributed, we then tested for homogeneity of variances using Levene's test. This is done simply by performing a standard ANOVA on the absolute value of the residuals. The residuals are the individual values within a study area minus the mean value of the study area. The formula for the residuals is:

$$z_{ij} = | x_{ij} - \bar{x}_i |$$

where:  $z_{ij}$  = residual for the  $j^{\text{th}}$  analyte concentration from the  $i^{\text{th}}$  study area;  
 $x_{ij}$  = the natural logarithm of the  $j^{\text{th}}$  analyte concentration from the  $i^{\text{th}}$  study area; and  
 $\bar{x}_i$  = arithmetic average of the natural logarithm of the analyte concentrations at the  $i^{\text{th}}$  study area.

For example, the first of the five residuals for the background ravine is calculated as follows:

$$z_{BKGDRAV,1} = | \ln 24.7 - 3.666543 | = 0.46$$

The average value above of 3.666543 was taken from the SAS® Univariate Procedure output mean for RAAREA=BKGDRAV.

An example of the 12<sup>th</sup> of the 12 residuals for the Hutchinson Ravine area follows.

$$z_{HRAV,12} = | \ln 540 - 4.86928 | = 1.42$$

An example of the 4<sup>th</sup> of the nine residuals for the Janes Ravine area follows.

$$z_{JRAV,4} = | \ln 29.5 - 3.498437 | = 0.11$$

A standard ANOVA was run on these 26 residuals. Since the calculations for ANOVA are extremely complex, example calculations are not provided for this example, but are provided for the ANOVA on the natural logarithm-transformed data in example calculation #4. The procedure can be found in Section 5.2 of the EPA's *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities*:

*Interim Final Guidance* (1989) or in many standard statistical textbooks. The SAS® General Linear Models Procedure output for Levene's test follows.

Levene's Test -- ANOVA on Residuals to Check for Homogeneity of Variances  
 4. Sodium in Surface Water (mg/L) -- Human Risk Assessment  
 SAS® Output

----- MEDIUM=SW CHEMNAME=Sodium FTBGS=All -----

General Linear Models Procedure  
 Class Level Information

Class	Levels	Values
RAAREA	3	BKGDRAV HRAV JRAV

Number of observations in by group = 26

Dependent Variable: RESID

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.38875065	0.19437532	0.80	0.4596
Error	23	5.55869339	0.24168232		
Corrected Total	25	5.94744404			

	R-Square	C.V.	Root MSE	RESID Mean
	0.065364	89.18173	0.49161196	0.55124740

Source	DF	Type I SS	Mean Square	F Value	Pr > F
RAAREA	2	0.38875065	0.19437532	0.80	0.4596

Source	DF	Type III SS	Mean Square	F Value	Pr > F
RAAREA	2	0.38875065	0.19437532	0.80	0.4596

Since the "Pr>F" of 0.4596 value is greater than 0.05, we cannot reject the null hypothesis that the variances are equal in favor of the alternate hypothesis that the variances are not equal and can conclude that the variances are not significantly different.

Because the %ND were less than 15, the data were lognormally distributed, and the variances were homogeneous, we applied a parametric ANOVA to the sodium surface water data.

The following computations are made to perform a parametric ANOVA on the natural logarithm-transformed data [ $y=\ln(x)$ ]. The value of  $y_i$  is the sum of the individual natural logarithm-transformed concentrations for study area  $i$  ( $i=1,2,3$ ) and is expressed as:

$$y_i = \sum_{j=1}^{n_i} y_{ij}$$

where:  $n_i$  = total number of observations at study area  $i$ , ranging from 1 to 3;  
 $i$  = study area, ranging from 1 to 3; and  
 $j$  = an individual observation number for a given study area, ranging from 7 to 13.

For example, for the background ravine,  $y_i$  is  $\ln(24.7) + \ln(29.0) + \ln(43.1) + \ln(53.4) + \ln(55.55) = 18.33$ . For Hutchinson Ravine,  $y_i$  is  $\ln(39.9) + \ln(58.2) + \ln(58.3) + \ln(86.1) + \ln(92.0) + \ln(149) + \ln(177) + \ln(178) + \ln(195) + \ln(204) + \ln(220) + \ln(540) = 58.43$ . For Janes Ravine,  $y_i$  is  $\ln(8.02) + \ln(10.9) + \ln(26.7) + \ln(29.5) + \ln(33.1) + \ln(34.4) + \ln(43.5) + \ln(61.0) + \ln(227) = 31.49$ . These sums correspond to the SAS® Univariate Procedure output “Sum” values.

The value of  $y_{..}$  is the sum of the  $y_i$  values and is expressed as:

$$y_{..} = \sum_{i=1}^a y_i$$

where:  $a$  = total number of study areas = 3.

The value of  $y_{..}$  in this example is  $18.33 + 58.43 + 31.49 = 108.25$ .

The sum of squares for the study areas,  $SS_{Study\ Area}$ , is expressed as:

$$SS_{Study\ Area} = \left( \sum_{i=1}^a \frac{y_i^2}{n_i} \right) - \frac{y_{..}^2}{n}$$

where:  $n$  = total number of concentrations at all three study areas =  $5 + 12 + 9 = 26$ .

In this example,  $SS_{Study\ Area}$  is:

$$SS_{Study\ Area} = \left( \frac{18.33^2}{5} + \frac{58.43^2}{12} + \frac{31.49^2}{9} \right) - \frac{108.25^2}{26} = 11.19$$

The total sum of squares,  $SS_{Total}$ , is expressed as:

$$SS_{Total} = \left( \sum_{i=1}^a \sum_{j=1}^{n_i} y_{ij}^2 \right) - \frac{y_{..}^2}{n}$$

In this example,  $SS_{Total}$  is:

$$SS_{Total} = \left[ (\ln 24.7)^2 + (\ln 29.0)^2 + \dots + (\ln 61.0)^2 + (\ln 227)^2 \right] - \frac{108.25^2}{26} = 25.04$$

The error sum of squares,  $SS_{Error}$ , is simply the  $SS_{Total} - SS_{Study\ Area}$  or  $25.04 - 11.19 = 13.85$ .

To obtain the mean square values, simply divide the sums of squares by the corresponding degrees of freedom. To obtain the F value, simply divide the mean square for the study area ( $MS_{Study\ Area}$ ) by the mean square for the error  $MS_{Error}$ . A shell for an ANOVA table follows.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Study Area	$a-1=3-1=2$	$SS_{Study\ Area}=11.19$	$MS_{Study\ Area}=5.60$	$\frac{MS_{Study\ Area}}{MS_{Error}} = 9.3$
Error	$n.-a=26-3=23$	$SS_{Error}=13.85$	$MS_{Error}=0.60$	
Total	$n.-1=26-1=25$	$SS_{Total}=25.04$		

The null hypothesis is rejected at the  $\alpha=0.05$  significance level if the F value of 9.3 is greater than or equal to the table value of F at an  $\alpha$  level of 0.05 with 2 and 23 degrees of freedom which is 3.422. Since 9.3 is greater than or equal to 3.422, we can reject the null hypothesis that the study area means are equal in favor of the alternate hypothesis that at least two treatment means are different. The actual significance level that corresponds to an F value of 9.3 with 2 and 23 degrees of freedom is 0.0011, which is highly significant.

The SAS® General Linear Models Procedure output that corresponds to the above “hand calculations” follows.

Parametric ANOVA  
4. Sodium in Surface Water (mg/L) -- Human Risk Assessment  
SAS® Output

----- MEDIUM=SW CHEMNAME=Sodium FTBGS=All -----

General Linear Models Procedure  
Class Level Information

Class	Levels	Values
RAAREA	3	BKGDRAV HRAV JRAV

Number of observations in by group = 26

Dependent Variable: LNCONC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	11.19311496	5.59655748	9.30	0.0011
Error	23	13.84816011	0.60209392		
Corrected Total	25	25.04127507			

R-Square	C.V.	Root MSE	LNCONC Mean
0.446987	18.63707	0.77594711	4.16346168

Source	DF	Type I SS	Mean Square	F Value	Pr > F
RAAREA	2	11.19311496	5.59655748	9.30	0.0011

Source	DF	Type III SS	Mean Square	F Value	Pr > F
RAAREA	2	11.19311496	5.59655748	9.30	0.0011

Since the "Prob > F" value of 0.0011 is less than 0.05, we can conclude that there is a significant difference between two or three of the BKGDRAV, HRAV, and JRAV sodium surface water concentrations. We can reject the null hypothesis that the mean concentrations for the background ravine, Hutchinson Ravine, and Janes Ravine are equal in favor of the alternate hypothesis that one or more of the concentrations are different.

A multiple comparison procedure must be performed to tell us which of the means are significantly different. Several multiple comparison procedures are available in the General Linear Models Procedure in SAS® to include pairwise least significant difference (LSD) t tests, Bonferroni t tests, and Duncan's multiple range tests. Calculations for the pairwise LSD t test follows. We can assume a significant difference between study area concentrations if:

$$|\bar{y}_1 - \bar{y}_2| \geq t_{\alpha/2, df_i} \sqrt{\frac{MS_e}{n_1} + \frac{MS_e}{n_2}}$$

The logarithmic means of the sodium concentrations in surface water at the background ravine, Hutchinson Ravine, and Janes Ravine are 3.667, 4.869, and 3.498, respectively. The value of  $t_{\alpha/2,23}$  is 2.069, where  $\alpha$  is 0.05. From the ANOVA table, we see that  $MS_e$  is 0.602.

Comparing background ravine concentrations with Hutchinson Ravine concentrations, we obtain:

$$|3.667 - 4.869| \geq 2.069 \sqrt{\frac{0.602}{5} + \frac{0.602}{12}}$$

The left hand side of the equation above reduces to 1.202 and the right hand side of the equation reduces to 0.854. Since 1.202 is greater than or equal to 0.854, we conclude that surface water sodium concentrations at Hutchinson Ravine are significantly different from (elevated above) concentrations at the background ravine study area. Since the concentrations in Hutchinson Ravine are elevated above background, the surface water sodium data for Hutchinson Ravine are carried forward in the human risk assessment.

Comparing background ravine concentrations with Janes Ravine concentrations, we obtain:

$$|3.667 - 3.498| \geq 2.069 \sqrt{\frac{0.602}{5} + \frac{0.602}{9}}$$

The left hand side of the equation above reduces to 0.169 and the right hand side reduces to 0.895. Since 0.169 is not greater than or equal to 0.895, we conclude that surface water sodium concentrations at Janes Ravine are not significantly different from concentrations at the background ravine study area. Since the concentrations in Janes Ravine are not elevated above background, the surface water sodium data for Janes Ravine are not carried forward in the human risk assessment.

SAS® output for the pairwise LSD t tests follows. Results using the other multiple comparison procedures were always similar.

---

T Test (LSD) Multiple Comparison Procedure for Variable: LNCONC  
4. Sodium in Surface Water (mg/L) -- Human Risk Assessment  
SAS Output

NOTE: This test controls the type I comparisonwise error rate not the experimentwise error rate.

Alpha= 0.05 df= 23 MSE= 0.602094

Critical Value of T= 2.07

Least Significant Difference= 0.8231

WARNING: Cell sizes are not equal.

Harmonic Mean of cell sizes= 7.605634

Means with the same letter are not significantly different.

T Grouping	Mean	N	RAAREA
A	4.869	12	HRAV
B	3.667	5	BKGDRAV
B	3.498	9	JRAV



## **Appendix D**

### **Screening Values**

## **Appendix D1**

Appendix D1. Available Screening Values for the Chemicals Detected in the Surplus OU Beach/Ravine Sediment (Page 1 of 4)

Analyte	PRG carc. (mg/kg)	PRG Noncarc. (mg/kg)	PRG Source	SSL (mg/kg)
2,4,5-T	nc	6.52E+02	USEPA Region IX PRGs, 8/1/96	--
Acenaphthene	nc	3.03E+03	USEPA Region IX PRGs, 8/1/96	4.70E+03
Acenaphthylene	nc	1.96E+03	PRGs for most toxic non-naphthalene PAH (pyrene) [USEPA Region IX PRGs, 8/1/96]	--
Aldrin	2.61E-02	1.96E+00	USEPA Region IX PRGs, 8/1/96	4.00E-02
Aluminum	nc	7.67E+04	USEPA Region IX PRGs, 8/1/96	--
Anthracene	nc	1.90E+04	USEPA Region IX PRGs, 8/1/96	2.30E+04
Antimony	nc	3.07E+01	USEPA Region IX PRGs, 8/1/96	3.10E+01
Arsenic	3.77E-01	2.21E+01	USEPA Region IX PRGs, 8/1/96	4.00E-01
Barium	nc	5.27E+03	USEPA Region IX PRGs, 8/1/96	5.50E+03
Benz(a)anthracene	6.09E-01	--	USEPA Region IX PRGs, 8/1/96	9.00E-01
Benzo(a)pyrene	6.09E-02	--	USEPA Region IX PRGs, 8/1/96	9.00E-02
Benzo(b)fluoranthene	6.09E-01	--	USEPA Region IX PRGs, 8/1/96	9.00E-01
Benzo(ghi)perylene	nc	1.96E+03	PRGs for most toxic non-naphthalene PAH (pyrene) [USEPA Region IX PRGs, 8/1/96]	--
Benzo(k)fluoranthene	6.09E+00	--	USEPA Region IX PRGs, 8/1/96	9.00E+00
Benzoic acid	nc	2.61E+05	USEPA Region IX PRGs, 8/1/96	3.10E+05
Beryllium	1.43E-01	3.83E+02	USEPA Region IX PRGs, 8/1/96	1.00E-01
Bis(2-ethylhexyl) phthalate	3.17E+01	1.30E+03	USEPA Region IX PRGs, 8/1/96	4.60E+01
Cadmium	1.40E+03	3.83E+01	USEPA Region IX PRGs, 8/1/96	7.80E+01
Calcium	nc	--	no PRGs developed; essential nutrient	--
Carbazole	2.22E+01	--	USEPA Region IX PRGs, 8/1/96	3.20E+01
Chlordane, alpha-	3.42E-01	3.91E+00	PRGs for chlordane, total [USEPA Region IX PRGs, 8/1/96]	--
Chlordane, gamma-	3.42E-01	3.91E+00	PRGs for chlordane, total [USEPA Region IX PRGs, 8/1/96]	--
Chlordane, total	3.42E-01	3.91E+00	USEPA Region IX PRGs, 8/1/96	5.00E-01
Chromium, total	2.11E+02	--	USEPA Region IX PRGs, 8/1/96	2.70E+02
Chrysene	6.09E+01	--	USEPA Region IX PRGs, 8/1/96	8.80E+01
Cobalt	nc	4.57E+03	USEPA Region IX PRGs, 8/1/96	--
Copper	nc	2.85E+03	USEPA Region IX PRGs, 8/1/96	--
Cyanide, total	nc	1.30E+03	PRGs for cyanide, free [USEPA Region IX PRGs, 8/1/96]	1.60E+03
DDD, p,p'-	1.85E+00	--	USEPA Region IX PRGs, 8/1/96	3.00E+00
DDE, p,p'-	1.31E+00	--	USEPA Region IX PRGs, 8/1/96	2.00E+00
DDT, p,p'-	1.31E+00	3.26E+01	USEPA Region IX PRGs, 8/1/96	2.00E+00
Di-n-butyl phthalate	nc	6.52E+03	USEPA Region IX PRGs, 8/1/96	2.30E+03
Dibenz(ah)anthracene	6.09E-02	--	USEPA Region IX PRGs, 8/1/96	9.00E-02
Dibenzofuran	nc	2.61E+02	USEPA Region IX PRGs, 8/1/96	--
Dinitrobenzene, 1,3-	nc	6.52E+00	USEPA Region IX PRGs, 8/1/96	--
Dinitrotoluene, 3,4-	nc	5.28E+02	PRGs developed from RfD based on acute oral rat LD50 (UF = 100,000)	2.30E+01
Endrin	nc	1.96E+01	USEPA Region IX PRGs, 8/1/96	3.10E+03
Fluoranthene	nc	2.61E+03	USEPA Region IX PRGs, 8/1/96	3.10E+03
Fluorene	nc	2.47E+03	USEPA Region IX PRGs, 8/1/96	5.00E-01
Hexachlorocyclohexane, gamma- (Lindane)	3.42E-01	1.96E+01	USEPA Region IX PRGs, 8/1/96	9.00E-01
Indeno(1,2,3-cd)pyrene	6.09E-01	--	USEPA Region IX PRGs, 8/1/96	9.00E-01

Appendix D1. Available Screening Values for the Chemicals Detected in the Surplus OU Beach/Ravine Sediment (Page 2 of 4)

Analyte	PRG carc. (mg/kg)	PRG Noncarc. (mg/kg)	PRG Source	SSL (mg/kg)
Iron	nc	2.30E+04	PRGs developed from RfD from USEPA Region III RBC Table, 10/22/97	--
Lead	nc	4.00E+02	residential soil screening level [USEPA Region IX PRGs, 8/1/96]	4.00E+02
Magnesium	nc	--	no PRGs developed; essential nutrient	--
Manganese	nc	3.78E+02	USEPA Region IX PRGs, 8/1/96	--
Mercury	nc	2.30E+01	PRGs developed from RfD from USEPA HEAST, 1997 Annual	--
Methoxychlor	nc	3.26E+02	USEPA Region IX PRGs, 8/1/96	3.90E+02
Methylnaphthalene, 1-	nc	1.96E+03	PRGs for most toxic non-naphthalene PAH (pyrene) [USEPA Region IX PRGs, 8/1/96]	--
Methylnaphthalene, 2-	nc	1.96E+03	PRGs for most toxic non-naphthalene PAH (pyrene) [USEPA Region IX PRGs, 8/1/96]	--
Naphthalene	nc	1.65E+03	USEPA Region IX PRGs, 8/1/96	3.10E+03
Nickel	1.05E+04	1.53E+03	USEPA Region IX PRGs, 8/1/96	1.60E+03
Organic carbon, total (TOC)	nc	--	no PRGs developed; general parameter	--
Petroleum hydrocarbons, total (TPH)	nc	2.87E+02	PRGs for hexane [USEPA Region IX PRGs, 8/1/96]	--
Phenanthrene	nc	1.96E+03	PRGs for most toxic non-naphthalene PAH (pyrene) [USEPA Region IX PRGs, 8/1/96]	--
Potassium	nc	--	no PRGs developed; essential nutrient	--
Pyrene	nc	1.96E+03	USEPA Region IX PRGs, 8/1/96	2.30E+03
Selenium	nc	3.83E+02	USEPA Region IX PRGs, 8/1/96	3.90E+02
Silver	nc	3.83E+02	USEPA Region IX PRGs, 8/1/96	3.90E+02
Sodium	nc	--	no PRGs developed; essential nutrient	--
Thallium	nc	6.13E+00	PRGs for thallium chloride [USEPA Region IX PRGs, 8/1/96]	--
Toluene	nc	1.91E+03	USEPA Region IX PRGs, 8/1/96	6.50E+02
Trichlorofluoromethane	nc	7.08E+02	USEPA Region IX PRGs, 8/1/96	--
Triphenylene	nc	1.96E+03	PRGs for most toxic non-naphthalene PAH (pyrene) [USEPA Region IX PRGs, 8/1/96]	--
Vanadium	nc	5.37E+02	USEPA Region IX PRGs, 8/1/96	5.50E+02
Xylenes, total	nc	1.32E+04	USEPA Region IX PRGs, 8/1/96	4.10E+02
Zinc	nc	2.30E+04	USEPA Region IX PRGs, 8/1/96	2.30E+04

Note: nc = noncarcinogenic.  
-- = not determined.

Appendix D1. Available Screening Values for the Chemicals Detected in the Surplus OU Beach/Ravine Sediment (Page 3 of 4)

Analyte	SSL Source	TACO (mg/kg)	TACO Source
2,4,5-T	--	--	--
Acenaphthene	ingestion (SSLs, 5/96, App. A)	4.70E+03	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Acenaphthylene	--	--	--
Aldrin	ingestion (SSLs, 5/96, App. A)	4.00E-02	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Aluminum	--	--	--
Anthracene	ingestion (SSLs, 5/96, App. A)	2.30E+04	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Antimony	ingestion (SSLs, 5/96, App. A)	3.10E+01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Arsenic	ingestion (SSLs, 5/96, App. A)	4.00E-01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Barium	ingestion (SSLs, 5/96, App. A)	5.50E+03	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Benz(a)anthracene	ingestion (SSLs, 5/96, App. A)	9.00E-01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Benzo(a)pyrene	ingestion (SSLs, 5/96, App. A)	9.00E-02	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Benzo(b)fluoranthene	ingestion (SSLs, 5/96, App. A)	9.00E-01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Benzo(ghi)perylene	--	--	--
Benzo(k)fluoranthene	ingestion (SSLs, 5/96, App. A)	9.00E+00	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Benzoic acid	ingestion (SSLs, 5/96, App. A)	3.10E+05	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Beryllium	ingestion (SSLs, 5/96, App. A)	1.00E-01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Bis(2-ethylhexyl) phthalate	ingestion (SSLs, 5/96, App. A)	4.60E+01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Cadmium	ingestion (SSLs, 5/96, App. A)	7.80E+01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Calcium	--	--	--
Carbazole	ingestion (SSLs, 5/96, App. A)	3.20E+01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Chlordane, alpha-	--	--	--
Chlordane, gamma-	--	--	--
Chlordane, total	ingestion (SSLs, 5/96, App. A)	5.00E-01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Chromium, total	inhalation of fugitive dust (SSLs, 5/96, App. A)	2.70E+02	based on inhalation (35 IAC 742, App. B, Table A, 6/05/97)
Chrysene	ingestion (SSLs, 5/96, App. A)	8.80E+01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Cobalt	--	--	--
Copper	--	--	--
Cyanide, total	value for amenable cyanide [ingestion (SSLs, 5/96, App. A)]	1.60E+03	ingestion value for cyanide, amenable (35 IAC 742, App. B, Table A, 6/05/97)
DDD, p,p'-	ingestion (SSLs, 5/96, App. A)	3.00E+00	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
DDE, p,p'-	ingestion (SSLs, 5/96, App. A)	2.00E+00	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
DDT, p,p'-	ingestion (SSLs, 5/96, App. A)	2.00E+00	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Di-n-butyl phthalate	inhalation (SSLs, 5/96, App. A)	2.30E+03	based on inhalation (35 IAC 742, App. B, Table A, 6/05/97)
Dibenz(ah)anthracene	ingestion (SSLs, 5/96, App. A)	9.00E-02	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Dibenzofuran	--	--	--
Dinitrobenzene, 1,3-	--	--	--
Dinitrotoluene, 3,4-	--	--	--
Endrin	--	--	--
Fluoranthene	ingestion (SSLs, 5/96, App. A)	2.30E+01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Fluorene	ingestion (SSLs, 5/96, App. A)	3.10E+03	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Hexachlorocyclohexane, gamma- (Lindane)	ingestion (SSLs, 5/96, App. A)	5.00E-01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Indeno(1,2,3-cd)pyrene	ingestion (SSLs, 5/96, App. A)	9.00E-01	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)

Appendix D1. Available Screening Values for the Chemicals Detected in the Surplus OU Beach/Ravine Sediment (Page 4 of 4)

Analyte	SSL Source	TACO (mg/kg)	TACO Source
Iron	-- ingestion (SSLs, 5/96, App. A)	--	--
Lead	--	4.00E+02	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Magnesium	--	--	--
Manganese	--	3.70E+03	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Mercury	--	1.00E+01	based on inhalation (35 IAC 742, App. B, Table A, 6/05/97)
Methoxychlor	ingestion (SSLs, 5/96, App. A)	3.90E+02	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Methylnaphthalene, 1-	--	--	--
Methylnaphthalene, 2-	--	--	--
Naphthalene	ingestion (SSLs, 5/96, App. A)	3.10E+03	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Nickel	ingestion (SSLs, 5/96, App. A)	1.60E+03	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Organic carbon, total (TOC)	--	--	--
Petroleum hydrocarbons, total (TPH)	--	--	--
Phenanthrene	--	--	--
Potassium	--	--	--
Pyrene	ingestion (SSLs, 5/96, App. A)	2.30E+03	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Selenium	ingestion (SSLs, 5/96, App. A)	3.90E+02	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Silver	ingestion (SSLs, 5/96, App. A)	3.90E+02	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Sodium	--	--	--
Thallium	--	6.30E+00	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Toluene	inhalation (SSLs, 5/96, App. A)	6.50E+02	based on inhalation (35 IAC 742, App. B, Table A, 6/05/97)
Trichlorofluoromethane	--	--	--
Triphenylene	--	--	--
Vanadium	ingestion (SSLs, 5/96, App. A)	5.50E+02	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)
Xylenes, total	value for 1,2-isomer [inhalation (SSLs, 5/96, App. A)]	4.10E+02	based on inhalation (35 IAC 742, App. B, Table A, 6/05/97)
Zinc	ingestion (SSLs, 5/96, App. A)	2.30E+04	based on ingestion (35 IAC 742, App. B, Table A, 6/05/97)

Note: nc = noncarcinogenic.

-- = not determined.

## **Appendix D2**

Appendix D2. Available Screening Values for the Chemicals Detected in the Surplus OU Beach/Ravine Surface Water (Page 1 of 4)

Analyte	PRG carc. (ug/L)	PRG Noncarc. (ug/L)	PRG Source
2,4-D	nc	3.65E+02	USEPA Region IX PRGs, 8/1/96
Acetone	nc	6.08E+02	USEPA Region IX PRGs, 8/1/96
Aluminum	nc	3.65E+04	USEPA Region IX PRGs, 8/1/96
Anthracene	nc	1.83E+03	USEPA Region IX PRGs, 8/1/96
Arsenic	4.48E-02	1.10E+01	USEPA Region IX PRGs, 8/1/96
Barium	nc	2.56E+03	USEPA Region IX PRGs, 8/1/96
Benzo(a)pyrene	9.21E-03	--	USEPA Region IX PRGs, 8/1/96
Benzo(k)fluoranthene	9.21E-01	--	USEPA Region IX PRGs, 8/1/96
Bis(2-ethylhexyl) phthalate	4.80E+00	7.30E+02	USEPA Region IX PRGs, 8/1/96
Boron	nc	3.29E+03	USEPA Region IX PRGs, 8/1/96
Butylbenzyl phthalate	nc	7.30E+03	USEPA Region IX PRGs, 8/1/96
Calcium	nc	--	no PRGs developed; essential nutrient
Chloride	nc	--	no PRGs developed; essential nutrient
Chloroform	1.65E-01	6.08E+01	USEPA Region IX PRGs, 8/1/96
Chloromethane	1.51E+00	--	USEPA Region IX PRGs, 8/1/96
Copper	nc	1.36E+03	USEPA Region IX PRGs, 8/1/96
Cyanide, total	nc	7.30E+02	PRGs for cyanide, free [USEPA Region IX PRGs, 8/1/96]
DDD, p,p' -	2.80E-01	--	USEPA Region IX PRGs, 8/1/96
DDE, p,p' -	1.98E-01	--	USEPA Region IX PRGs, 8/1/96
DDT, p,p' -	1.98E-01	1.83E+01	USEPA Region IX PRGs, 8/1/96
Decachlorobiphenyl	nc	7.30E-01	PRGs for PCB 1254 [USEPA Region IX PRGs, 8/1/96]
Fluoranthene	nc	1.46E+03	USEPA Region IX PRGs, 8/1/96
Fluoride	nc	2.19E+03	USEPA Region IX PRGs, 8/1/96
Hexachlorocyclohexane, gamma- (Lindane)	5.17E-02	1.10E+01	USEPA Region IX PRGs, 8/1/96
Iron	nc	4.69E+03	PRGs developed from RfD from USEPA Region III RBC Table, 10/22/97
Lead	nc	1.50E+01	drinking water action level [USEPA, 1994b]
Magnesium	nc	--	no PRGs developed; essential nutrient
Manganese	nc	1.83E+02	USEPA Region IX PRGs, 8/1/96
Mercury	nc	1.10E+01	PRGs developed from RfD from USEPA HEAST, 1997 Annual
Nitrogen, NO2+NO3	nc	3.65E+03	PRGs for nitrite [USEPA Region IX PRGs, 8/1/96]
Organic carbon, total (TOC)	nc	--	no PRGs developed; general parameter
Potassium	nc	--	no PRGs developed; essential nutrient
Pyrene	nc	1.10E+03	USEPA Region IX PRGs, 8/1/96
Sodium	nc	--	no PRGs developed; essential nutrient



Appendix D2. Available Screening Values for the Chemicals Detected in the Surplus OU Beach/Ravine Surface Water (Page 2 of 4)

Analyte	PRG carc. (ug/L)	PRG Noncarc. (ug/L)	PRG Source
Sulfate	nc	1.78E+05	PRGs developed from RfD based on proposed MCL [USEPA, NPDWR, 1994]
Toluene	nc	7.23E+02	USEPA Region IX PRGs, 8/1/96
Triphenylene	nc	1.10E+03	PRGs for most toxic non-naphthalene PAH (pyrene) [USEPA Region IX PRGs, 8/1/96]
Vanadium	nc	2.56E+02	USEPA Region IX PRGs, 8/1/96
Zinc	nc	1.10E+04	USEPA Region IX PRGs, 8/1/96

Note: nc = noncarcinogenic.  
 -- = not determined.

Appendix D2. Available Screening Values for the Chemicals Detected in the Surplus OU Beach/Ravine Surface Water (Page 3 of 4)

Analyte	620 (ug/L)	Source
2,4-D	3.50E+02	IAC 35 Part 620, Class II Groundwater Standards
Acetone	7.00E+02	IAC 35 Part 620, Class II Groundwater Standards
Aluminum	--	--
Anthracene	--	--
Arsenic	2.00E+02	IAC 35 Part 620, Class II Groundwater Standards
Barium	2.00E+03	IAC 35 Part 620, Class II Groundwater Standards
Benzo(a)pyrene	2.00E+00	IAC 35 Part 620, Class II Groundwater Standards
Benzo(k)fluoranthene	--	--
Bis(2-ethylhexyl) phthalate	6.00E+01	IAC 35 Part 620, Class II Groundwater Standards
Boron	2.00E+03	IAC 35 Part 620, Class II Groundwater Standards
Butylbenzyl phthalate	--	--
Calcium	--	--
Chloride	2.00E+05	IAC 35 Part 620, Class II Groundwater Standards
Chloroform	--	--
Chloromethane	--	--
Copper	6.50E+02	IAC 35 Part 620, Class II Groundwater Standards
Cyanide, total	6.00E+02	IAC 35 Part 620, Class II Groundwater Standards
DDD, p,p'-	--	--
DDE, p,p'-	--	--
DDT, p,p'-	--	--
Decachlorobiphenyl	2.50E+00	IAC 35 Part 620, Class II Groundwater Standards
Fluoranthene	--	--
Fluoride	4.00E+03	IAC 35 Part 620, Class II Groundwater Standards
Hexachlorocyclohexane, gamma- (Lindane)	1.00E+00	IAC 35 Part 620, Class II Groundwater Standards
Iron	5.00E+03	IAC 35 Part 620, Class II Groundwater Standards
Lead	1.00E+02	IAC 35 Part 620, Class II Groundwater Standards
Magnesium	--	--
Manganese	1.00E+04	IAC 35 Part 620, Class II Groundwater Standards
Mercury	1.00E+01	IAC 35 Part 620, Class II Groundwater Standards
Nitrogen, NO2+NO3	--	--
Organic carbon, total (TOC)	--	--
Potassium	--	--
Pyrene	--	--
Sodium	--	--

Appendix D2. Available Screening Values for the Chemicals Detected in the Surplus OU Beach/Ravine Surface Water (Page 4 of 4)

Analyte	620 (ug/L)	Source
Sulfate	4.00E+05	IAC 35 Part 620, Class II Groundwater Standards
Toluene	2.50E+03	IAC 35 Part 620, Class II Groundwater Standards
Triphenylene	--	--
Vanadium	--	--
Zinc	1.00E+04	IAC 35 Part 620, Class II Groundwater Standards

Note: nc = noncarcinogenic.  
 -- = not determined.

## **Appendix E**

### **Exposure Concentrations**

---

## Calculation of BRA Exposure Concentrations

Exposure concentrations are the contaminant concentrations that a receptor may contact within a study area. The exposure concentrations calculated for COPCs in this BRA are either the one-sided 95 percent upper confidence limit on the mean ( $UCL_{95}$ ) or the maximum detected concentration. The  $UCL_{95}$  is defined as a value that, when calculated repeatedly for randomly drawn subsets of site data, equals or exceeds the true mean 95 percent of the time (USEPA, 1992a). If the  $UCL_{95}$  exceeds the maximum detected concentration, then the maximum concentration is used as the exposure concentration. The algorithm used in calculating exposure concentrations is as follows:

1. Replace all values listed as less than the analytical detection limit by one-half the analytical detection limit (USEPA, 1992b).
2. Determine the goodness of fit to the lognormal distribution using the Shapiro-Wilk W test of normality on the natural logarithms of the data. The null hypothesis ( $H_0$ ) for this test is that the data are lognormally distributed; the alternative hypothesis ( $H_a$ ) for this test is that the data are not lognormally distributed. Lognormality is assessed by the normal option to the univariate procedure in SAS® (1989-1996). The SAS output provides p-values or significance levels for the computationally intensive W test ( $PROB < W$ ). Typically, rejection of the  $H_0$ , which indicates that the data do not follow a lognormal distribution, is indicated by  $PROB < W$  values of 0.05 or less; and failure to reject the  $H_0$ , which indicates that the data follow a lognormal distribution, is indicated by  $PROB < W$  values greater than 0.05. However, it has been shown that the arithmetic average of the untransformed data is a preferred estimator of the true mean value if the coefficient of variation (standard deviation divided by the mean; CV) is believed to be less than 1.2 (Gilbert, 1987).
3. As mentioned in Step 2, when the CV is less than 1.2, normal distribution theory procedures are used to estimate the  $UCL_{95}$  (Gilbert, 1987). In the exposure concentration tables, this case is indicated by "CV Norml".
4. When the CV exceeds 1.2, the data are first tested to see if they are lognormally distributed as indicated by a  $PROB < W$  LN of 0.05 or more. If the p-value is equal to or exceeds 0.05, the case is "Lognormal". If the p-value does not exceed 0.05, the data are tested for normality. If the  $PROB < W$  ACT is 0.05 or higher, the case is "Normal". Otherwise, the lognormal case is assumed, as environmental data are typically lognormally distributed. This case is referred to as "None Lgn". Once the approximate distribution is determined, then the  $UCL_{95}$  equation for normal or lognormal distributions is used (Gilbert, 1987; USEPA, 1992a). The normal and lognormal  $UCL_{95}$  equations are as follows:

$$Normal\ UCL_{95} = \bar{x} + t_{\alpha, n-1} \left( \frac{s}{\sqrt{n}} \right) \quad (1)$$

where:  $UCL_{95}$  = upper 95 percent confidence limit on the mean;

$$\bar{x} = \text{sample arithmetic mean} = \frac{1}{n} \sum_{i=1}^n x_i;$$

$t$  = "t" values are from Student's t distribution and is based on (n-1) degrees of freedom (df);

$\alpha$  = the probability of a Type I error which is equivalent to rejecting the  $H_0$  given that  $H_0$  is true; in this case,  $\alpha = 0.95$ , which is equivalent to a one-tailed confidence interval with a probability of a Type I error at 0.05;

$s$  = sample standard deviation =  $\sqrt{s^2}$ ;

$s^2$  = sample variance =  $\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$ ; and

$n$  = number of samples.

$$\text{Lognormal } UCL_{95} = e^{\left( \bar{y} + 0.5s^2 + \frac{SH}{\sqrt{n-1}} \right)} \quad (2)$$

where:  $UCL_{95}$  = upper 95 percent confidence limit on the mean;

$e$  = constant (base of the natural log, equal to 2.718);

$y_i$  =  $\ln(x_i)$

$\bar{y}$  = sample arithmetic mean =  $\frac{1}{n} \sum_{i=1}^n y_i$ ;

$s$  = sample standard deviation =  $\sqrt{s^2}$ ;

$s^2$  = sample variance =  $\frac{1}{n-1} \sum_{i=1}^n (y_i - \bar{y})^2$ ;

$H$  = H-statistic [e.g. from table published in Gilbert (1987)]; and

$n$  = number of samples.

5. When the  $UCL_{95}$  exceeds the maximum positively quantified value in the data set (maximum hit), the results of nondetect data with unusually high contract reporting limits (CRLs) are evaluated, all nondetects where the CRL was greater than the maximum hit are deleted, and Steps 2 through 4 are repeated.
6. Exposure concentrations equal either the  $UCL_{95}$  or maximum hit, whichever is smaller. The  $UCL_{95}$  value will be the same as the maximum hit value when the sample size is small. In such cases, the exposure concentrations are the same as the maximum hit concentrations.

---

Summaries of the exposure concentrations calculated for the COPCs chosen for each study area and used in quantifying potential exposures in the human and ecological BRAs are presented in this appendix and Appendix K, respectively.

Appendix E. Human Exposure Concentrations  
Fort Sheridan Surplus Operable Unit Beach/Ravine BRA

15:02 Friday, March 6, 1998 1

Medium	Study Area	Analyte	Upper		Total Number	# of Detects	Coefficient of Variation	Normal S-W p-value	Lognormal S-W p-value	Maximum Detected Concentrn	Exposure Concentrn	Delete Nondetect > Max Hit
			95% Limit	Conf Assumed Distribn								
Sediment	Beach	Arsenic	6.85E+00	CV Norml	11	11	5.45E-01	2.50E-03	2.87E-01	1.31E+01	6.85E+00	
		Beryllium	2.51E-01	CV Norml	5	1	7.27E-01	0.00E+00	0.00E+00	3.41E-01	2.51E-01	Yes
		Manganese	4.68E+02	CV Norml	11	11	3.41E-01	4.59E-01	8.28E-01	6.27E+02	4.68E+02	
Sediment	Hutchinson Ravine	Benz(a)anthracene	1.64E+01	Lognorml	11	8	1.94E+00	2.90E-05	1.00E-01	1.00E+01	1.00E+01	
		Benz(b)pyrene	8.56E+00	Lognorml	11	11	1.87E+00	3.67E-05	8.41E-02	8.00E+00	8.00E+00	
		Benz(o)fluoranthene	8.52E+00	None Lgn	11	8	1.85E+00	4.12E-05	3.70E-02	8.00E+00	8.00E+00	
		Benz(k)fluoranthene	7.64E+00	Lognorml	11	9	1.77E+00	6.22E-05	5.92E-01	5.00E+00	5.00E+00	
		Chlordane, total	7.65E-01	None Lgn	10	5	2.32E+00	3.29E-06	1.62E-02	9.30E-01	7.65E-01	
		Chrysene	1.65E+01	Lognorml	11	8	1.60E+00	1.94E-04	7.99E-01	1.00E+01	1.00E+01	
		DDD, P,P'-	3.44E+01	Lognorml	11	11	2.15E+00	6.26E-06	9.98E-01	1.00E+01	1.00E+01	
		Dibenz(ah)anthracene	2.70E-01	CV Norml	11	2	1.08E+00	8.86E-03	9.90E-01	6.00E-01	2.70E-01	
		Indeno(1,2,3-cd)pyrene	4.21E+00	Lognorml	11	6	1.86E+00	2.43E-05	2.05E-01	4.00E+00	4.00E+00	
		Benz(a)anthracene	1.23E-01	CV Norml	11	3	6.82E-01	5.61E-03	7.37E-02	2.30E-01	1.23E-01	Yes
Surface Water	Janes Ravine	Benz(a)pyrene	1.72E-01	CV Norml	11	4	8.45E-01	1.50E-03	1.49E-01	3.60E-01	1.72E-01	Yes
		Benz(b)fluoranthene	1.93E-01	CV Norml	11	4	9.51E-01	1.01E-04	3.43E-03	4.30E-01	1.93E-01	Yes
		Benz(k)fluoranthene	1.34E-01	CV Norml	11	4	8.48E-01	1.77E-02	3.52E-01	2.80E-01	1.34E-01	Yes
		Chlordane, total	1.68E+01	None Lgn	10	5	2.81E+00	1.17E-06	8.83E-03	5.20E+00	5.20E+00	
		Chrysene	1.47E-01	CV Norml	11	5	8.20E-01	2.86E-04	6.45E-02	3.30E-01	1.47E-01	Yes
		DDD, P,P'-	1.21E+04	Lognorml	10	7	2.02E+00	4.17E-05	2.98E-01	6.60E+00	6.60E+00	
		DDT, P,P'-	6.70E+02	Lognorml	10	9	2.02E+00	4.09E-05	3.43E-01	5.90E+00	5.90E+00	
		Dibenz(ah)anthracene	8.55E-02	CV Norml	4	2	9.94E-01	4.28E-01	9.54E-01	9.40E-02	8.55E-02	Yes
		Indeno(1,2,3-cd)pyrene	1.35E-01	CV Norml	9	2	6.95E-01	2.71E-02	1.55E-01	2.40E-01	1.35E-01	Yes
		Chloroform	1.38E-03	CV Norml	4	1	1.15E+00	0.00E+00	0.00E+00	1.60E-03	1.38E-03	
Surface Water	Hutchinson Ravine	Manganese Sulfate	2.76E-01	CV Norml	4	4	5.49E-01	9.45E-01	9.04E-01	2.83E-01	2.76E-01	
		Benz(a)pyrene	2.48E+02	CV Norml	4	4	4.97E-01	2.57E-01	6.24E-01	2.69E+02	2.48E+02	
		Benz(k)fluoranthene	1.11E-05	CV Norml	5	1	6.25E-01	0.00E+00	0.00E+00	1.47E-05	1.11E-05	Yes
		Bis(2-ethylhexyl) phthalate	3.72E-03	None Lgn	12	2	1.59E+00	6.89E-07	1.44E-05	8.75E-06	8.75E-06	Yes
		Chloromethane	8.54E-03	None Lgn	7	1	1.55E+00	1.67E-05	1.00E-04	1.40E-02	3.72E-03	
		Manganese Sulfate	8.91E-01	CV Norml	12	12	1.17E+00	1.71E-03	4.22E-01	1.20E-02	8.54E-03	
			1.55E+02	CV Norml	9	9	5.43E-01	7.29E-01	6.80E-02	1.81E+00	8.91E-01	
										2.00E+02	1.55E+02	
		Manganese	1.65E-01	CV Norml	9	8	6.97E-01	4.15E-01	1.63E-02	2.21E-01	1.65E-01	

Note: Units for sediment are mg/kg and for surface water are mg/L.

Source: QST, 1998.

C:\proj\sheridan\surlpsou\beachrav\bra2\append2\expoconc.lst



Appendix E. Human Exposure Concentrations  
Fort Sheridan Surplus Operable Unit Beach/Ravine BRA

Note:	Upper 95% Conf Limit	=	One-sided upper 95 percent confidence limit on the mean determined for either the lognormally or normally distributed data set
	Assumed Distribn	=	Data set [lognormal or normal] chosen to calculate the upper 95 percent confidence limit where "CV Norml" indicates that the data are assumed to be normally distributed because the coefficient of variation (CV) is less than 1.2, "None Lgn" indicates that the data were found to be neither normally or lognormally distributed by the Shapiro-Wilk test and were assumed to be lognormally distributed since most environmental data are lognormally distributed, and "Lognorml" indicates that the data were found to be lognormally distributed as a result of the Shapiro-Wilk test.
	Total Number	=	Number of records
	Coefficient of Variation	=	Untransformed sample standard deviation divided by the untransformed arithmetic mean
	Normal S-W p-value	=	Shapiro-Wilk W statistic (with Royston modification) for determining if the data are normally distributed. Values closer to unity indicate that the data are normally distributed.
	Lognormal S-W p-value	=	Shapiro-Wilk W statistic (with Royston modification) for determining if the data are lognormally distributed. Values closer to unity indicate that the data are lognormally distributed.
	Maximum Detected Concentrn	=	Maximum detected concentration
	Exposure Concentrn	=	The exposure concentration is either the upper 95 percent confidence limit (UCL95) or the maximum detected concentration. If the UCL95 exceeds the maximum detected concentration, then the maximum detected concentration is used as the exposure concentration. Otherwise, the UCL95 is used as the exposure concentration.
	Delete Nondetect > Max Hit	=	A "Yes" in this column means that when the UCL95 exceeds the maximum positively quantified value in the data set, all nondetects have been deleted where the detection limit is greater than the maximum hit. Note that "Yes" does not necessarily indicate the omission of below the detection limit data -- it merely indicates the possibility of the omission of below the detection limit data.

## **Appendix F**

### **Human Intake Estimation Method and Exposure Factors**

---

## HUMAN INTAKE ESTIMATION: METHODS AND EXPOSURE FACTORS

### 1.0 Introduction

QST Environmental uses internally-generated software called the Automated Risk Evaluation System (ARES) to estimate the exposure of various receptors to environmental chemicals and the risks associated with those exposures. Using ARES Version 3.0, operated within the SAS/STAT Version 6.12 structure (SAS, 1996), daily chemical exposures are calculated for each completed pathway for each potential receptor using appropriate exposure formulas and factors presented in various USEPA guidance documents, including the Risk Assessment Guidance for Superfund (RAGS), Human Health Evaluation Manual, Part A (USEPA, 1989), Part B (USEPA, 1991a), and Supplemental Guidance (USEPA, 1991b); Dermal Exposure Assessment: Principles and Applications (USEPA, 1992); USEPA Region IX's Preliminary Remediation Goals (PRGs) Guidance (1996a); Illinois EPA (IEPA) guidance on the Tiered Approach to Corrective Action Objectives (TACO) (IEPA, 1997) and Dermal Risk Assessment (IEPA, 1994); and USEPA Region V guidance (1997c). Where appropriate, exposure factors based on site-specific information are used in place of USEPA standard default values. After determining daily exposures, ARES calculates the potential carcinogenic and noncarcinogenic risks associated with those exposures using appropriate cancer slope factors (CSFs) and risk reference doses (RfDs) available from various USEPA sources, including the Integrated Risk Information System (IRIS) (USEPA, 1997b), Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997a), and the USEPA National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center (values presented in USEPA, 1996a). Where no RfD is available, a provisional value is calculated following USEPA suggested guidance (1989). The following documentation provides a list of the exposure scenarios (Section 2.0), the exposure formulas (Section 3.0), and the exposure factors (Section 4.0) used to calculate the chemical intakes for the Fort Sheridan Surplus OU, as well as the references used to develop ARES (Section 5.0).

### 2.0 Exposure Scenarios Evaluated in ARES

Due to the presence of multiple contamination areas in the Fort Sheridan Surplus OU, multiple exposure scenarios were developed to facilitate easier risk calculations. Exposure scenarios are unique for receptor, exposure pathways, and exposure parameters. The study areas evaluated in the Surplus OU Beach/Ravines BRA are as follows:

- Hutchinson Ravine,
- Janes Ravine, and
- Beach (includes beach outflow areas from Hutchinson and Janes Ravines, as well as the airport drain.

The exposure scenarios evaluated include current recreational (golfers incidentally exposed to ravine sediment/surface water) and future recreational (hikers exposed to ravine and beach sediment/surface water). A list of the exposure scenarios, the study areas to which each scenario applies, and the exposure pathways applicable to each scenario are presented in Table F-1.

Table F-1. Exposure Scenarios with Applicable Contamination Areas and Exposure Pathways

Scenario *	Applicable Study Areas	Sediment		Surface Water	
		Dermal	Oral	Dermal	Oral
Current Recreational (golfer)	Hutchinson Ravine	X	X	X	X
	Janes Ravine	X	X	X	X
Future Recreational A (hiker)	Hutchinson Ravine	X	X	X	X
	Janes Ravine	X	X	X	X
Future Recreational B (hiker)	Beach **	X	X	X	X

Note: X = This receptor/pathway is evaluated in ARES based on measured concentrations in sediment and/or surface water at the study area.

\* Scenarios are unique for receptors, pathways, and exposure parameters.

A letter (A,B, etc.) after a scenario indicates that while the exposure pathways may be the same, different exposure parameters are applicable. For example, although Future Recreational A and Future Recreational B will have the same exposure pathways, the exposure parameters for like pathways are different.

\*\* Beach includes all samples collected from ravine effluent areas, as well as from the airport drain outflow.

Source: QST.

{SHERIDAN.SURPLSOU.BEACHRAV.ARES2/V-SCNMAP.WB2/dhc/26Feb98}

---

### 3.0 Exposure Formulas Used in ARES

The exposure formulas incorporated in ARES are based on the formulas given in IEPA's TACO Guidance (1997), USEPA Region IX's PRG Guidance (1996a), and USEPA's RAGS Part A (USEPA, 1989) and Part B (USEPA, 1991a). Identifiers have been added to the basic exposure factor abbreviations to differentiate those factors that are used in multiple formulas. The following formulas are used in the ARES for the Fort Sheridan Surplus OU Beach/Ravines HRA:

#### 3.1 Sediment, Dermal Exposure

For adult and child exposures:

$$Intake (mg/kg/day) = \frac{CSe * FCs * SAse * AF * ABS * EFse * ED}{BW * AT} \quad (1)$$

Where:

- ABS = chemical-specific absorption factor (unitless).
- AF = sediment-to-skin adherence factor (mg/cm<sup>2</sup>).
- AT = period of time over which exposure is averaged (days).
- BW = body weight (kg).
- CSe = chemical concentration in sediment (mg/kg).
- ED = exposure duration (years).
- EFse = exposure frequency for sediment (events/year).
- FCs = conversion factor for sediment (kg/mg).
- SAse = skin surface area available for sediment contact (cm<sup>2</sup>/event).

For lifetime exposure:

$$Intake (mg/kg/day) = \frac{CSe * SFSe_{adj} * FCs * ABS * EFse}{AT} \quad (2)$$

Where:

- ABS = chemical-specific absorption factor (unitless).
- CSe = chemical concentration in sediment (mg/kg).
- EFse = exposure frequency for sediment (days/year).
- FCs = conversion factor for sediment (kg/mg).
- SFSe<sub>adj</sub> = Age-adjusted skin contact factor for sediment (mg·year/kg·day).

---

### 3.2 Sediment, Oral Exposure

For adult and child exposures:

$$Intake (mg/kg/day) = \frac{C_{Se} * IR_{se} * FC_s * FI_s * EF_{se} * ED}{BW * AT} \quad (3)$$

Where: AT = averaging time (days).  
BW = body weight (kg).  
C<sub>Se</sub> = chemical concentration in sediment (mg/kg).  
ED = exposure duration (years).  
EF<sub>se</sub> = exposure frequency for sediment (days/year).  
FC<sub>s</sub> = conversion factor for sediment (kg/mg).  
FI<sub>s</sub> = fraction of sediment ingested from contaminated source (unitless).  
IR<sub>se</sub> = sediment ingestion rate (mg/day).

For lifetime exposure:

$$Intake (mg/kg/day) = \frac{C_{Se} * IF_{Se_{adj}} * FC_s * FI_s * EF_{se}}{AT} \quad (4)$$

Where: AT = averaging time (days).  
C<sub>Se</sub> = chemical concentration in sediment (mg/kg).  
EF<sub>se</sub> = exposure frequency for sediment (days/year).  
FC<sub>s</sub> = conversion factor for sediment (kg/mg).  
FI<sub>s</sub> = fraction of sediment ingested from contaminated source (unitless).  
IF<sub>Se<sub>adj</sub></sub> = Age-adjusted ingestion factor for sediment (mg·year/kg·day).

---

### 3.3 Surface Water, Dermal Exposure

For adult and child exposures:

$$Intake (mg/kg/day) = \frac{C_{SW} * FC_w * SA_{sw} * PC * ET_{sw} * EF_{sw} * ED}{BW * AT} \quad (5)$$

Where: AT = period of time over which exposure is averaged (days).  
BW = body weight (kg).

CSW = chemical concentration in surface water (mg/L).  
 ED = exposure duration (years).  
 EFsw = exposure frequency for surface water (days/year).  
 ETsw = exposure time for surface water (hours/day).  
 FCw = volumetric conversion factor for water (L/cm<sup>3</sup>).  
 PC = dermal permeability constant (cm/hour).  
 SASw = skin surface area available for contact with surface water (cm<sup>2</sup>).

For lifetime exposure:

$$Intake (mg/kg/day) = \frac{CSW * FCw * SFW_{adj} * PC * ETsw * EFsw}{AT} \quad (6)$$

Where: AT = period of time over which exposure is averaged (days).  
 CSW = chemical concentration in surface water (mg/L).  
 EFsw = exposure frequency for surface water (days/year).  
 ETsw = exposure time for surface water (hours/day).  
 FCw = volumetric conversion factor for water (L/cm<sup>3</sup>).  
 PC = dermal permeability constant (cm/hour).  
 SFW<sub>adj</sub> = Age-adjusted skin contact factor for water (cm<sup>2</sup>·year/kg).

### 3.4 Surface Water, Oral Exposure

$$Intake (mg/kg/day) = \frac{CSW * IRsw * ETsw * EFsw * ED}{BW * AT} \quad (7)$$

Where: AT = period of time over which exposure is averaged (days).  
 BW = body weight (kg).  
 CSW = chemical concentration in surface water (mg/L).  
 ED = exposure duration (years).  
 EFsw = exposure frequency for surface water (days/year).  
 ETsw = exposure time for surface water (hours/day).  
 IRsw = intake rate for surface water (L/hour).

---

#### 4.0 Exposure Factors Used in ARES

Exposure factors are taken from the EPA Region IX PRG Guidance (1996a), unless otherwise specified. If presented in the PRG guidance, the original source for each factor is also given in parentheses.

#### 4.1 ABS

ABS values for the sediment COPCs are presented in Table F-2. Sources for the ABS values are described below.

##### Organic chemicals other than PAHs

ABS is the greater of the following:

1. The EPA Region V value (1997c), and
2. A predicted value using a model developed by McKone (1991) and adopted for use by IEPA (1994) that classifies organic chemicals into one of five groups based on the chemical's dimensionless Henry's Law constant ( $H^0$ ) and octanol-water partition coefficient ( $K_{ow}$ ). The groupings and their respective ABS values are as follows:

<u><math>H^0</math></u>	<u><math>K_{ow}</math></u>	<u>ABS</u>
$H^0 \leq 0.01$	$\leq 10^6$	1.0
$H^0 \leq 0.01$	$> 10^6$	0.4
$0.01 < H^0 \leq 0.1$	$\leq 10^1$	0.4
$0.01 < H^0 \leq 0.1$	$> 10^1$	0.03
$H^0 > 0.1$	---	0.03

For sediment COPCs where IEPA ABS > USEPA Region V ABS,  $H^0$  and  $K_{ow}$  are presented in Table F-3.

---

##### PAHs

No ABS values are required. According to IEPA guidance (1994), the risk from dermal exposure to PAHs is equivalent to the oral risk; thus, the oral exposure formula is used to estimate dermal risk, as well.

---

##### Inorganic chemicals

0.01

Default value.

IEPA, 1994

---



---

#### 4.2 AF

0.2 mg/cm<sup>2</sup>

The lower end of the measured range for the hand; assumed to be the best value to represent an average over all exposed skin (USEPA, 1992).

---

#### 4.3 AT

Carcinogenic effects  
Noncarcinogenic effects

70 years x 365 days/year  
ED (years) x 365 days/year

(USEPA, 1989)  
(USEPA, 1989)

---

#### 4.4 BW

##### Adult

70 kg

Default value; average (male and female) of  
50<sup>th</sup> percentile values for age = 18 to 75 years.

IEPA, 1997

For lifetime exposure to potential carcinogens in sediment and/or surface water (dermal exposure), see the time-weighted exposure factors SFSe<sub>adj</sub>, IFSe<sub>adj</sub>, and/or SFW<sub>adj</sub> in this documentation.

-----

##### Child

15 kg

Default value; average (male and female) of  
50<sup>th</sup> percentile values for age = 1 to 6 years.

(USEPA, 1991b)

-----

##### Lifetime (Future Recreational Surface Water Ingestion)

59 kg

Assumes a child body weight of 15 kg for 6 years and an adult body weight of 70 kg for 24 years.

$$\frac{(15 \text{ kg} \times 6 \text{ years}) + (70 \text{ kg} \times 24 \text{ years})}{30 \text{ years}} = 59 \text{ kg} \quad (8)$$

---

#### 4.5 CSe / CSW

The upper 95 percent confidence limit of the mean chemical concentration (UCL<sub>95</sub>) was used to represent the RME exposure concentration. If the UCL<sub>95</sub> exceeded the maximum detected

---

chemical concentration, the maximum concentration was used to represent the RME. All pertinent samples collected from the study area were used in the calculations. An explanation of the RME exposure concentration calculation process is presented in App. E.

---

#### 4.6 ED

##### Recreational: Current and Future (Adult)

30 years	Default value; national 90 <sup>th</sup> percentile time at one residence.	IEPA, 1997
----------	--	------------

For lifetime exposure to potential carcinogens in sediment and/or surface water, see the time-weighted exposure factors SFSe<sub>adj</sub>, IFSe<sub>adj</sub>, and/or SFW<sub>adj</sub> in this documentation.

-----

##### Recreational: Future (Child)

6 years	Assumes exposure for children age = 1 to 6 years, inclusive, in rural/residential areas.	(USEPA, 1991b)
---------	--	----------------

Because current recreational exposure at Hutchinson and Janes Ravines is limited to golfers, current recreational exposure of young children is not a viable scenario and is not evaluated for the ravines.

---

#### 4.7 EFse / EFsw

##### Recreational: Current (Adult and Lifetime)

35 events/year	Assumes that a golfer may be inadvertently exposed to sediment and/or surface water in Hutchinson and Janes Ravines 1 day/week when the maximum daily air temperature exceeds 32°F (35 weeks/year) (NOAA, 1992).
35 days/year	

Because current recreational exposure at Hutchinson and Janes Ravines is limited to golfers, current recreational exposure of young children is not a viable scenario and is not evaluated for the ravines.

-----

---

Recreational: Future (Adult, Child, and Lifetime)

***Future Recreational A***

70 events/year

70 days/year

Assumes that persons may be inadvertently exposed to sediment and/or surface water while hiking in the ravines 2 days/week when the maximum daily air temperature exceeds 32°F (35 weeks/year) (NOAA, 1992).

***Future Recreational B***

140 events/year

140 days/year

Assumes that persons may be inadvertently exposed to sediment and/or surface water while walking on the beach 4 days/week when the maximum daily air temperature exceeds 32°F (35 weeks/year) (NOAA, 1992).

---

**4.8 ET<sub>sw</sub>**

Recreational: Current (Adult and Lifetime)

0.083 hours/day

Assumes that a golfer may inadvertently contact surface water in Hutchinson and Janes Ravines for 5 minutes while golfing.

-----

Recreational: Future (Adult)

0.25 hours/day

Assumes that an adult hiking in Hutchinson or Janes Ravine or walking on the beach may inadvertently contact surface water for 15 minutes.

-----

Recreational: Future (Child)

***Future Recreational A***

0.25 hours/day

Assumes that a child recreating in Hutchinson or Janes Ravine may inadvertently contact surface water for 15 minutes/day.

-----

***Future Recreational B***

1.0 hour/day

Assumes that a child playing on the beach may contact standing surface water for 1 hour/day.

-----

---

**Recreational; Future (Lifetime)**

***Future Recreational A***

0.25 hours/day

Assumes that a child or an adult recreating in Hutchinson or Janes Ravine may inadvertently contact surface water for 15 minutes/day.

***Future Recreational B***

0.4 hours/day

Assumes a child exposure time of 1 hour/day for 6 years and an adult exposure time of 0.25 hours/day for 24 years.

$$\frac{(1 \text{ hour/day} \times 6 \text{ years}) + (0.25 \text{ hours/day} \times 24 \text{ years})}{30 \text{ years}} = 0.4 \text{ hours/day (9)}$$

---

**4.9 FCs**

$1 \times 10^{-6}$  kg/mg

---

**4.10 FCw**

0.001 L/cm<sup>3</sup>

---

**4.11 FIs**

**Recreational; Current (Adult and Lifetime)**

- 0.1 Assumes that 10 percent of daily sediment ingestion is from inadvertent contact with sediment in Hutchinson and Janes Ravines while golfing.

Because current recreational exposure at Hutchinson and Janes Ravines is limited to golfers, current recreational exposure of young children is not a viable scenario and is not evaluated for the ravines.

---

**Recreational; Future (Adult, Child, and Lifetime)**

- 0.5 Assumes that 50 percent of sediment ingestion on recreational days is from the recreational area.

#### 4.12 IFSe<sub>adj</sub>

$$IFSe_{adj} (mg \cdot year / kg \cdot day) = \sum_{i=1}^2 \frac{IRse_i \cdot ED_i}{BW_i} \quad (10)$$

Where:  $BW_i$  = body weight (kg; age-dependent).  
 $ED_i$  = exposure duration (years; age range for particular ingestion rate).  
 $IRse_i$  = sediment ingestion rate (mg/day; age-dependent).

##### Recreational; Current (Lifetime)

43 mg·year/kg·day

<u>i</u>	<u>BW</u>	<u>ED</u>	<u>IRse</u>	<u>Comment</u>
1	70	30	100	assumed IRse for an adult golfer
2	--	--	--	no child exposure is anticipated

Because current recreational exposure at Hutchinson and Janes Ravines is limited to golfers, current recreational exposure of young children at the ravines is not considered a significant exposure scenario and is not evaluated.

---

##### Recreational; Future (Lifetime)

114 mg·year/kg·day

<u>i</u>	<u>BW</u>	<u>ED</u>	<u>IRse</u>	<u>Comment</u>
1	15	6	200	IRso for a child, ages 1 to 6, inclusive
2	70	24	100	IRso for a non-child, ages 7 to 30, inclusive

---

#### 4.13 IRse

##### Recreational; Current (Adult)

100 mg/day

Conservative value assumes default adult residential  
soil ingestion rate.

IEPA, 1997

Because current recreational exposure at Hutchinson and Janes Ravines is limited to golfers, current recreational exposure of young children at the ravines is not considered a significant exposure scenario and is not evaluated.

---

Recreational: Current (Lifetime)

For lifetime current recreational exposure to potential carcinogens in sediment, see the time-weighted exposure factor  $IFSe_{adj}$  for current recreational exposure in this documentation.

-----

Recreational: Future (Adult)

100 mg/day	Conservative value assumes default adult residential soil ingestion rate.	IEPA, 1997
------------	---	------------

-----

Recreational: Future (Child)

200 mg/day	Conservative value assumes default child residential soil ingestion rate.	(USEPA, 1991b)
------------	---	----------------

-----

Recreational: Future (Lifetime)

For lifetime future recreational exposure to potential carcinogens in sediment, see the time-weighted exposure factor  $IFSe_{adj}$  for future recreational exposure in this documentation.

---

**4.14 IR<sub>sw</sub>**

0.005 L/hour	Assumed value for incidental exposure of hikers in the ravines and persons recreating on the beach.
--------------	---

Although the default value for ingestion of surface water is 0.05 L/hour (USEPA, 1989), this value is based on the national average for swimming. Because the water intermittently present in the ravines and on the beach is not of sufficient size or duration to provide adequate water for swimming, the default value is considered overly conservative and not appropriate for this BRA. Although the potential may exist for hikers to occasionally contact surface water during recreational activities, ingestion of surface water resulting from this incidental contact is highly unlikely and is included as a conservative estimate of potential exposure.

---

**4.15 PC**

PCs for inorganic chemicals are either experimentally measured values provided in Table 5-3 of USEPA's Dermal Exposure Assessment (1992) or the default value for water.

PCs for organic chemicals are either predicted  $K_p$  values provided in Table 5-7 (USEPA, 1992) or are calculated using Equation 5.11 (reproduced below from USEPA, 1992). PCs for the surface water COPCs are presented in Table F-4.

$$K_p = 10^{-2.72 + (0.71 \log K_{ow}) - (0.0061 MW)} \quad (11)$$

Where:  $K_{ow}$  = octanol/water partition coefficient, and  
MW = molecular weight.

#### 4.16 SAs<sub>e</sub> / SAs<sub>w</sub>

##### Adult: All Scenarios

5,000 cm<sup>2</sup>/event

Default value; 25% of total adult surface area.

(USEPA, 1992)

##### Child: All Scenarios

2,000 cm<sup>2</sup>/event

Default value; 25% of total child surface area.

(USEPA, 1992)

##### Lifetime: All Scenarios

For lifetime recreational exposure to potential carcinogens in sediment and/or surface water, see the time-weighted exposure factors SFSe<sub>adj</sub> and SFW<sub>adj</sub>, respectively, in this documentation.

#### 4.17 SFSe<sub>adj</sub>

$$SFSe_{adj} (mg \cdot year / kg \cdot day) = \sum_{i=1}^2 \frac{ED_i \cdot AF \cdot SAs_{e_i}}{BW_i} \quad (12)$$

Where: AF = sediment-to-skin adherence factor (mg/cm<sup>2</sup>).  
BW<sub>i</sub> = body weight (kg; age-dependent).  
ED<sub>i</sub> = exposure duration (years; age range for particular ingestion rate).  
SAs<sub>e,i</sub> = skin surface area available for sediment contact (cm<sup>2</sup>/event; age-dependent).

---

Recreational: Current (Lifetime)

429 mg·year/kg·day

<u>i</u>	<u>AF</u>	<u>BW</u>	<u>ED</u>	<u>SAse</u>	<u>Comment</u>
1	0.2	70	30	5,000	Adult SAse
2	--	--	--	--	no child exposure is anticipated

Because current recreational exposure at Hutchinson and Janes Ravines is limited to golfers, current recreational exposure of young children at the ravines is not considered a significant exposure scenario and is not evaluated.

-----

Recreational: Future (Lifetime)

503 mg·year/kg·day

<u>i</u>	<u>AF</u>	<u>BW</u>	<u>ED</u>	<u>SAse</u>	<u>Comment</u>
1	0.2	15	6	2,000	Child SAse
2	0.2	70	24	5,000	Adult SAse

---

4.18  $SFW_{adj}$

$$SFW_{adj} (cm^2 \cdot year/kg) = \sum_{i=1}^2 \frac{ED_i * SASw_i}{BW_i} \quad (13)$$

Where:  $BW_i$  = body weight (kg; age-dependent).  
 $ED_i$  = exposure duration (years; age range for particular ingestion rate).  
 $SASw_i$  = skin surface area available for water contact ( $cm^2$ ; age-dependent).

Recreational: Current (Lifetime)

1,710  $cm^2 \cdot year/kg$

<u>i</u>	<u>BW</u>	<u>ED</u>	<u>SAsw</u>	<u>Comment</u>
1	70	24	5,000	Adult SAsw
2	--	--	--	no child exposure is anticipated

Because current recreational exposure at Hutchinson and Janes Ravines is limited to golfers, current recreational exposure of young children at the ravines is not considered a significant exposure scenario and is not evaluated.

-----



---

Recreational: Future (Lifetime)

2,510 cm<sup>2</sup>·year/kg

<u>i</u>	<u>BW</u>	<u>ED</u>	<u>SAsw</u>	<u>Comment</u>
1	15	6	2,000	Child SAsw
2	70	24	5,000	Adult SAsw

---

Table F-2. ABS Values for the Sediment COPCs

COPC	ABS *	Source
Arsenic	0.03	EPA Reg. V Comments on Ft. Sheridan Surplus OU Draft ARES.DOC, 1/14/97 (a)
Benz(a)anthracene	na	IEPA, Dermal Absorption Memo, 1994 (b)
Benzo(a)pyrene	na	IEPA, Dermal Absorption Memo, 1994 (b)
Benzo(b)fluoranthene	na	IEPA, Dermal Absorption Memo, 1994 (b)
Beryllium	0.01	IEPA, Dermal Absorption Memo, 1994 (c)
Chlordane, total	0.4	IEPA, Dermal Absorption Memo, 1994 (d)
DDD, p,p'-	0.4	IEPA, Dermal Absorption Memo, 1994 (d)
DDT, p,p'-	0.4	IEPA, Dermal Absorption Memo, 1994 (d)
Diben(z)anthracene	na	IEPA, Dermal Absorption Memo, 1994 (b)
Indeno(1,2,3-cd)pyrene	na	IEPA, Dermal Absorption Memo, 1994 (b)
Manganese	0.01	IEPA, Dermal Absorption Memo, 1994 (c)

Note: na = use of an ABS value is not applicable for PAHs.

- (a) Chemical-specific value.
- (b) According to IEPA (1994), dermal risk for PAHs is equal to oral risk; therefore, the risk equations for oral exposure are used to calculate dermal risks, as well.
- (c) Default value for inorganics.
- (d) Based on Henry's Law Constant (H) and Kow (see Table F-3).

\* Based on IEPA methodology (1994), but using the greater of the ABS values provided by EPA Region V and IEPA for non-PAH organics.

Source: QST.

{SHERIDAN.SURPLSOU.BEACHRAV.ARES2/V-ABS.WB2/dbc/26Feb98}

Table F-3. Calculation of ABS Values for Non-PAH Organic COPCs

COPC	H (a) (dimensionless)	Kow (a) (L/kg)	ABS (b) (unitless)
Chlordane, total	1.99E-03	2.09E+06	0.40
DDD, p,p'-	1.64E-04	1.26E+06	0.40
DDT, p,p'-	3.32E-04	3.39E+06	0.40

(a) EPA, 1996b.

(b) ABS determined based on model developed by McKone (1991) and adopted by IEPA (1994).

If  $H \leq 0.01$  and  $Kow \leq 1E+6$ , then  $ABS = 1.0$ .

If  $H \leq 0.01$  and  $Kow > 1E+6$ , then  $ABS = 0.4$ .

If  $0.01 < H \leq 0.1$  and  $Kow \leq 1E+1$ , then  $ABS = 0.4$ .

If  $0.01 < H \leq 0.1$  and  $Kow > 1E+1$ , then  $ABS = 0.03$ .

If  $H > 0.1$ , then  $ABS = 0.03$ .

Source: QST.

{SHERIDAN.SURPLSOU.BEACHRAV.ARES2/V-ABSDEV.WB2/dbc/26Feb98}

Table F-4. PCs for the Surface Water COPCs

COPC	PC	Source *
Benzo(a)pyrene	1.2E+00	predicted Kp (Table 5-7)
Bis(2-ethylhexyl) phthalate	1.2E+00	calculated Kp (based on Equation 5.11) **
Chloroform	8.9E-03	predicted Kp (Table 5-7)
Chloromethane	4.2E-03	predicted Kp (Table 5-7)
Manganese	1.0E-03	default value for water (Table 5-3)
Sulfate	1.0E-03	default value for water (Table 5-3)

\* USEPA, Dermal Exposure Assessment, 1992.

\*\*  $PC = 10^{[-2.72 + (0.71 * \log Kow) - (0.0061 * MW)]}$ , where  
 $MW = 391, \log Kow = 7.3$  (EPA, 1996b).

Source: QST.

{SHERIDAN.SURPLSOU.BEACHRAV.ARES2/V-PC.WB2/dbc/26Feb98}

---

## 5.0 References Used in Developing ARES

- California Environmental Protection Agency (Cal-EPA). 1994. *Preliminary Endangerment Assessment Guidance Manual*. Department of Toxic Substances Control (DTSC), Sacramento, CA.
- Illinois Environmental Protection Agency (IEPA). 1994. Memorandum from T. Hornshaw to J. O'Brien, re: *Interim Default Values for Estimation of the Dermal Absorption of Chemicals from Soil*. Springfield, IL. March 22, 1994.
- Illinois Environmental Protection Agency (IEPA). 1997. *Illinois Register, Title 35, Subtitle G, Chapter 1, Subchapter f, Part 742: Tiered Approach to Corrective Action Objectives (TACOs)*. Pollution Control Board, Springfield, IL. February 18, 1997.
- McKone, T.E. 1991. *Dermal Uptake of Organic Chemicals from a Soil Matrix*. Risk Analysis 10:407-419. (Cited in IEPA, 1994).
- National Oceanic and Atmospheric Administration (NOAA), Naval Oceanography Command Detachment Asheville, and USAFETAC. 1992. *International Station Meteorological Climate Summary for Glenview, Illinois*. National Climatic Data Center, Federal Climate Complex, Asheville, NC.
- SAS. 1996. *SAS/STAT® Procedures Guide*. Version 6.12. SAS Institute, Cary, NC.
- U.S. Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund (RAGS)*. Volume 1: Human Health Evaluation Manual, Part A. Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-89/002.
- U.S. Environmental Protection Agency (USEPA). 1991a. *Risk Assessment Guidance for Superfund (RAGS)*. Volume 1: Human Health Evaluation Manual, Part B (Development of Risk-Based Preliminary Remediation Goals). Office of Emergency and Remedial Response, Washington, DC. OERR 9285.7-01B.
- U.S. Environmental Protection Agency (USEPA). 1991b. *Risk Assessment Guidance for Superfund (RAGS)*. Volume 1: Human Health Evaluation Manual, Supplemental Guidance (Standard Default Exposure Factors). Interim Final. Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.6-03.
- U.S. Environmental Protection Agency (USEPA). 1992. *Dermal Exposure Assessment: Principles and Applications*. Interim Report. Prepared by Versar, Inc. Office of Research and Development, Washington, DC. EPA 600/8-91/011B. NTIS No. PB92-205665.
- U.S. Environmental Protection Agency (USEPA). 1995. *Exposure Factors Handbook*. Review Draft. Office of Research and Development, Washington, DC. EPA/600/P-95/002A. NTIS No. PB95-252532.

- 
- U.S. Environmental Protection Agency (USEPA). 1996a. *Region 9 Preliminary Remediation Goals 1996*. Prepared by S.J. Smucker, Technical Support Section, EPA Region IX, Sacramento, CA. August 1, 1996.
- U.S. Environmental Protection Agency (USEPA). 1996b. *Soil Screening Guidance: Technical Background Document*. Office of Emergency and Remedial Response, Washington, DC. EPA/540/R-95/128. NTIS No. PB96-963502.
- U.S. Environmental Protection Agency (USEPA). 1997a. *Health Effects Assessment Summary Tables (HEAST)*. FY-1997 Update. Office of Emergency and Remedial Response and Office of Research and Development, Washington, DC. EPA 540/R-97-036. Publication No. 9200.6-303(97-1). NTIS No. PB97-921199.
- U.S. Environmental Protection Agency (USEPA). 1997b. *Integrated Risk Information System (IRIS)*. On-line Database {[www.epa.gov/iris](http://www.epa.gov/iris)}. Washington, DC. Revised February 10, 1998.
- U.S. Environmental Protection Agency (USEPA). 1997c. Letter from W. Thompson, BRAC Remedial Project Manager, to C. Reilly, Base Environmental Coordinator, Ft. Sheridan, re: *Comments on Draft Human Intake Estimation: Methods and Exposure Factors for Ft. Sheridan, IL*. USEPA Region V, Chicago, IL. January 17, 1997.
- Weinner, K. 1992. Personal Communication, Letter to M. Bianchi, Environmental Science and Engineering, re: *Fort Sheridan Grass Cutting Schedule*. Fort Sheridan, West Deerfield Township, Lake County, MI.

## **Appendix G**

### **Toxicological Profiles**

## **QST Toxicological Profiles**



---

## *Toxicological Profile for Chloromethane*

### Introduction

Chloromethane is both a man-made and naturally occurring chemical. Man-made sources include industrial production, polyvinyl chloride burning, and wood burning. Natural sources include the oceans, microbial fermentation, and biomass fires (i.e., forest fires, grass fires). Methyl chloride is a gas at normal environmental temperatures. Chloromethane is used mainly in the production of silicones where it is used to methylate silicon (CMR, 1986). Chloromethane is also used in the production of agricultural chemicals, methyl cellulose, quaternary amines and butyl rubber. Virtually all of the uses for chloromethane are consumptive in that the chloromethane is reacted to form another product during use. Thus, the chloromethane is consumed when used and is no longer available for release, disposal or reuse (ATSDR, 1990).

Chloromethane is a gas at normal environmental temperatures and therefore is unlikely to remain in soil or water. Consequently, most chloromethane discharged to the environment will be released to the air where it will be subjected to transport and diffusion into the stratosphere. The major route of environmental degradation of methyl chloride is probably through oxidation. Chloromethane discharged to water will volatilize rapidly. Experimental studies have found the half-life of chloromethane in agitated water to be about 30 minutes (USEPA, 1985a). In soil, the dominant transport mechanism for chloromethane that is present near the surface is probably volatilization. Since chloromethane is not expected to sorb to soils, any chloromethane present in subsurface soil will be expected to leach to lower horizons as well as diffuse to the surface and volatilize.

### Pharmacokinetics

Inhalation Exposure--Chloromethane is absorbed readily from the lungs of humans following inhalation exposure. At relatively low exposure concentrations, absorption of chloromethane from the lungs appears to be proportional to exposure concentration in rats and humans, but at higher concentrations, some processes, such as metabolism or excretion become saturated, limiting the rate of uptake (ATSDR, 1990). After absorption, distribution of chloromethane and/or its metabolites is extensive in animals. Chloromethane has been observed in liver, kidney, heart, brain, lung, testes, muscle and intestine.

The majority of the chloromethane appears to be metabolized within the body and very little chloromethane is excreted. Chloromethane is metabolized through conjugation with glutathione and cysteine, leading to urinary excretion of sulfur containing compounds (Dodd *et al.*, 1982; Kornbrust and Bus, 1984; Landry *et al.*, 1983a, 1983b; Redford-Ellis and Gowenlock 1971a, 1971b). Production of methanethiol and formaldehyde, and lipid peroxidation due to glutathione depletion have been suggested as possible mechanisms for the toxicity of chloromethane, but the precise mechanisms are not known (Jaeger *et al.*, 1988; Kornbrust and Bus, 1983, 1984).

Two distinct populations of humans with differences in elimination of chloromethane have been identified. Stewart *et al.* (1980) found that some human volunteers exposed by inhalation had distinctly higher chloromethane concentrations in exhaled breath samples than others. Other studies (Nolan *et al.*, 1985; van Doorn *et al.*, 1980) support the speculation that there are two distinct populations: fast eliminators, with lower body burdens and higher excretion, and slow eliminators, with higher body burdens and lower excretion. While the observation of two distinct populations may have no toxicological significance (Nolan *et al.*, 1985), the reaction of chloromethane with glutathione may lead to the formation of toxic compounds that may exert their action before they are eliminated.

Oral Exposure--No information regarding absorption, distribution, metabolism or excretion in humans or animals following oral exposure to chloromethane is available.

Dermal Exposure--No information regarding absorption, distribution, metabolism or excretion in humans or animals following dermal exposure to chloromethane is available.

#### Bioaccumulation

Based on the log octanol/water partition coefficient (0.91) a bioconcentration factor of 2.98 has been calculated indicating that chloromethane will not concentrate significantly in aquatic organisms.

#### Toxicological Effects--Human Effects

##### Acute/Chronic Effects of Exposure

The central nervous system is the major target of chloromethane toxicity in both humans and animals, as demonstrated by such signs and symptoms as dizziness, staggering, blurred vision, ataxia, muscle incoordination, convulsions, and coma after acute exposure to high levels. The liver and kidney are also common targets of chloromethane toxicity in humans and animals after acute or longer-term exposure. Toxic manifestations observed in humans also include cardiovascular and gastrointestinal effects, which may be secondary to the neurotoxicity.

Chloromethane has been found to be carcinogenic in animals, however there is no evidence of carcinogenicity in humans. A significantly increased incidence of benign and malignant kidney tumors, and hepatocellular carcinoma has been demonstrated in male mice.

Case reports of humans exposed to chloromethane vapors have described clinical jaundice and cirrhosis of the liver (ATSDR, 1990), however the exposure concentrations that elicited these reactions are not known. Other systemic effects that have been reported include electrocardiogram abnormalities, tachycardia, increased pulse rate, and decreased blood pressure. Indicators of renal toxicity, such as albuminuria, increased serum creatinine and blood urea nitrogen, proteinuria, and anuria have been described in case reports of humans

exposed to high levels of chloromethane vapors due to refrigerator leaks (Kegel *et al.*, 1929; Mackie, 1961; Spevak *et al.*, 1976; Verriere and Vachez, 1949).

### Toxicological Effects--Environmental Effects

#### Acute/Chronic Effects of Exposure for Terrestrial Wildlife

The central nervous system appears to be the major target of chloromethane toxicity in animals. Effects that have been observed in some animals, but not reported in humans, include testicular atrophy, infertility, and sterility of male rats, kidney tumors in male mice, and possibly developmental effects (heart defects) in mice.

The only information available on the effects of chloromethane in wildlife is an acute study on the bluegill that reported an LC<sub>50</sub> value of 500 mg/L for this species. Data on the other chlorinated methanes indicate that aquatic toxicity declines with decreased chlorination. Thus chloromethane should be less toxic than chloroform or carbon tetrachloride, neither of which had any effect on *Daphnia magna* or the fathead minnow during chronic exposure to 3,400 µg/L. No information on the toxicity of chloromethane to terrestrial wildlife or domestic animals was found in the literature reviewed.

### Toxicological Criteria

Human Health Criteria--The USEPA has not established a chronic oral RfD or a subchronic oral RfD for chloromethane at this time (USEPA, 1997). The USEPA has classified chloromethane as a C carcinogen. The oral CSF value is  $1.3\text{E-}02 \text{ (mg/kg/day)}^{-1}$ , and the inhalation CSF is  $6.3\text{E-}03 \text{ (mg/kg/day)}^{-1}$  (USEPA, 1985b). The oral unit risk factor for chloromethane is  $3.7\text{E-}07 \text{ (µg/L)}^{-1}$ , and the inhalation unit risk factor for chloromethane is  $1.8\text{E-}06 \text{ (µg/m}^3\text{)}^{-1}$  (USEPA, 1985b). The ACGIH has determined a TLV value for chloromethane at 103 mg/m<sup>3</sup> (ACGIH, 1996).

### References

- Agency for Toxic Substances and Disease Registry 1990. Toxicological Profile for Chloromethane. U.S. Public Health Service. Atlanta, Georgia.
- American Conference of Governmental Industrial Hygienists 1996. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH.
- Chemical Marketing Reporter (CMR) 1986. Chemical Profile: Chloromethane. March 3, 1986.
- Dodd D.E., Bus J.S., and Barrow C.S. 1982. Nonprotein sulfhydryl alterations in F-344 rats following acute methyl chloride inhalation. *Toxicology and Applied Pharmacology* 62:228-236
- Hazardous Substance Data Bank (HSDB) 1997. Chloromethane. National Library of Medicine, National Toxicology Information Program.
- Jaeger R, Peter H, Sterzel W 1988. Biochemical effects of methyl chloride in relation to its tumorigenicity. *Journal of Cancer Research and Clinical Oncology* 114:64-70.

- Kegel AH, McNally WD, Pope AS. 1929. Methyl chloride poisoning from domestic refrigerators. *Journal of the American Medical Association* 93:353-358.
- Kornbrust DJ, and Bus JS 1983. The role of glutathione and cytochrome P-450 in the metabolism of methyl chloride. *Toxicology and Applied Pharmacology* 67:246-256.
- Kornbrust DJ, and Bus JS 1984. Glutathione depletion by methyl chloride and association with lipid peroxidation in mice and rats. *Toxicology and Applied Pharmacology* 72:388-399.
- Landry TD, Gushow TS, Langvardt PW 1983a. Pharmacokinetics and metabolism of inhaled methyl chloride in the rat and dog. *Toxicology and Applied Pharmacology* 68:473-486.
- Landry TD, Ramsey JC, McKenna, MJ 1983b. Pulmonary physiology and inhalation dosimetry in rats: Development of a method and two examples. *Toxicology and Applied Pharmacology* 71:72-73.
- Mackie IJ. 1961. Methyl chloride intoxication. *Medical Journal of Australia* 1:203-205.
- Nolan RJ, Rick DL, Landry TD 1985. Pharmacokinetics of inhaled methyl chloride ( $\text{CH}_3\text{Cl}$ ) in male volunteers. *Fundamentals of Applied Toxicology* 5:361-369.
- Redford-Ellis M, Gowenlock AH 1971a. Studies on the reaction of chloromethane with preparations of liver, brain and kidney. *Acta Pharmacology and Toxicology* 30:49-58.
- Redford-Ellis M, Gowenlock AH 1971b. Reaction of chloromethane with human blood. *Acta Pharmacology and Toxicology* 30:36-48.
- Spevak L, Nadj V, Felle D. 1976. Methyl chloride poisoning in four members of a family. *British Journal of Industrial Medicine* 33:272-274.
- Stewart RD, Hake CL, Zvu A 1980. Methyl chloride: Development of a biologic standard for the industrial worker by breath analysis. Prepared for National Institute for Occupational Safety and Health, Cincinnati, OH. NTIS PB81-167686.
- USEPA 1985a. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Waste Programs Enforcement. Washington, DC.
- USEPA 1985b. Health Effects Assessment Summary Tables (HEAST). Office of Research and Development. Washington, DC.
- USEPA 1997. Integrated Risk Information System (IRIS). USEPA database accessed through the National Library of Medicine (NLM). Bethesda, Maryland
- van Doorn R, Borm PJA, Leijdekkers C-M 1980. Detection and identification of S-methylcysteine in urine of workers exposed to methyl chloride. *International Archives of Occupational and Environmental Health* 46:99-110.
- Verriere MP, Vachez M. 1949. Severe acute nephritis after methyl chloride poisoning. *Lyon Medicine* 1:296-297. (French)

## ***Toxicological Profile for DDT, DDE, and DDD***

### **Introduction**

DDT is a man-made product first produced in 1874. In 1939 its insecticidal properties were discovered. DDE and DDD are found in small amounts as contaminants in technical grade DDT and they are metabolites of DDT (ATSDR, 1988). DDD was also used as a pesticide and one form was used medically to treat cancer of the adrenal gland. DDT was used extensively during World War II for the control of malaria, typhus, and other insect-transmitted diseases. It has been used worldwide for the control of insects. In the U.S. during 1972, 67% to 90% of the total usage of DDT was for cotton crops with the remainder primarily used on peanut and soybean crops. Peak usage of DDT occurred in 1963 with 80 million kg of DDT used. In 1973 it was estimated that 2 billion kg of DDT has been used for insect control since 1940 (ATSDR, 1988).

In 1972 the EPA announced that DDT could no longer be used in the U.S. except in the case of a public health emergency. The use of DDD as a pesticide was also banned. DDT is still used in several other areas of the world. In 1985, DDT was still produced for export at two U.S. facilities (ATSDR, 1988). There are also major producers of DDT in India and some Central and South American countries. Since 1972 there have been no imports of DDT into the U.S.

DDT is a white powder or colorless crystal with a weak aromatic odor. The molecular weight of DDT is 354.49. DDT is insoluble in water with a maximum water solubility of 0.0034 mg/L; however, DDT is very soluble in organic solvents such as ethyl ether, acetone, benzene, etc.. DDE is a white crystalline solid with a molecular weight of 318.03. DDE is slightly soluble in water (0.12 mg/L) and soluble in most organic solvents and lipids. DDD is a odorless solid white powder or colorless crystal. It has a molecular weight of 320.05 and is insoluble in water with a maximum water solubility of 0.160 mg/L.

DDT and its two primary metabolites DDE and DDD do not occur in nature. Releases of these chemicals into the environment are related to their formulation and use as insecticides (ATSDR, 1988). Due to the extensive past use of DDT worldwide and the persistence of DDT and its metabolites in the environment, these chemicals are found throughout the environment in water, soil and air and are continually being transformed and redistributed in the environment.

### **Pharmacokinetics**

**Inhalation Exposure**--In occupational settings, exposure has occurred by a mixture of exposure routes including inhalation with subsequent oral ingestion, and dermal absorption. Absorption of DDT by the lung is considered a minor route of exposure. Because of the large particle size of crystalline DDT, it does not enter the deeper spaces of the lung, rather is deposited in the upper respiratory tract and eventually swallowed (Hayes, 1982). Some crystalline DDT may be small enough to pass through the tracheal system. Absorption of DDT was indicated by the appearance of a DDT metabolite (DDA) in the urine (Laws *et al.*, 1967;

Ortelee, 1958) and the presence of DDT in adipose tissue, and plasma or serum (Laws *et al.*, 1967; Morgan *et al.*, 1980; Rabello *et al.* 1975).

Oral Exposure--Measurements of serum and adipose tissue concentrations of DDT, DDE, and DDD indicate absorption of these chemicals following ingestion (Hayes *et al.*, 1971; Morgan and Roan, 1971). The ratio of DDT stored in adipose tissue to that present in blood was estimated to be 280:1 (ATSDR, 1988).

Development of toxicity following accidental or intentional ingestion of DDT also indicates absorption (Hsieh, 1954). DDT appeared in the serum after ingestion by subjects chronically exposed to oral doses. The production of urinary metabolites in mice, rats, and hamsters, the presence of DDT and metabolites in bile collections, and the induction of tumors in experimental animals following oral administration of DDT, DDE, or DDD indicates gastrointestinal absorption (Fawcett *et al.*, 1987; Gold and Brunk, 1982, 1983, 1984; Jensen *et al.*, 1957).

Dermal Exposure--Dermal absorption, although limited, is inferred by observation of toxicity following dermal application of DDT in humans and animals (ATSDR, 1988). However, exposure via the dermal absorption route is considered to be negligible.

### Bioaccumulation

DDT, DDE, and DDD are highly lipid soluble and combined with a long half-life, have resulted in bioaccumulation. When present in ambient water, DDT and its metabolites are concentrated in freshwater and marine plankton, insects, mollusks, various invertebrates, and fish (ATSDR, 1988). A progressive accumulation of these chemicals results in high levels of residues in the organisms at the top of the food chain. There are numerous measurements and estimates of the bioconcentration factor (BCF) in fish. A steady-state BCF in rainbow trout of 12,000 was estimated (Oliver and Niimi, 1985). Transformation studies of DDT in soil indicate prolonged persistence where extensive DDT adsorption to soil particles occurs. Due to the tendency to adsorb to soil particles, DDT and its metabolites do not tend to leach to groundwater. When DDT is released to water it adsorbs to particles and is subject to sedimentation or it may bioconcentrate in microorganisms. Volatilization of DDT and DDE may account for a large part of the losses from soils and water (ATSDR, 1988). DDT has an estimated half-life of 100 days (Sleicher and Hopcraft, 1984). The estimated half-life of DDE in soil range from 2 to over 15 years (Lichtenstein *et al.*, 1959; Stewart and Chisholm, 1971).

### Toxicological Effects--Human Effects

#### Acute/Chronic Effects of Exposure

The central nervous system is a major target organ in humans for the effects of exposure to DDT, DDE, and DDD. Some central nervous system effects observed in humans occupationally exposed or through ingestion of DDT include cold moist skin, hypersensitivity to contact, tremor, and convulsion (ATSDR, 1988). Moderate irritation to the upper respiratory tract has been reported due to DDT exposure through the inhalation route (Neal *et al.*, 1944). Following accidental ingestion of DDT, tachycardia has occurred in

humans (Hsieh, 1954). One case of fatal poisoning was reported following accidental oral exposure to DDT mixed with kerosene (Hill and Robinson, 1945). There are no studies indicating an adverse effect on human reproduction from exposure to DDT (ATSDR, 1988). There is a possibility that DDT may potentially cause chromosomal damage. Studies of workers exposed to DDT were inconclusive as to the development of cancer from exposure to DDT. However, due to evidence from animal studies, EPA has classified DDT, DDE, and DDD as B2 carcinogens.

### **Toxicological Effects--Environmental Effects**

#### **Acute/Chronic Effects of Exposure for Terrestrial Wildlife**

Several studies have been conducted in a variety of species on the effects of exposure to DDT. The liver and central nervous system are major target organs in animals exposed to these chemicals (ATSDR, 1988). The LD<sub>50</sub> for rats following intraperitoneal and subcutaneous injections of DDT was 9.1 and 1500 mg/kg/day, respectively (Bathe *et al.*, 1976; Cameron, 1945). The LD<sub>50</sub> in mice through intraperitoneal exposure to DDT range from 32 to 333 mg p,p-DDT/kg (Bathe *et al.*, 1976; Okey and Page, 1974). The LD<sub>50</sub> for guinea pigs and rabbits following subcutaneous exposure to DDT was reported at 900 and 250 mg/kg, respectively (Cameron, 1945). Adverse liver effects include increased liver weight and elevated serum levels of liver enzymes (Agarwal *et al.*, 1978; de Waziers and Azais, 1987; Pasha, 1981). Ventricular fibrillation resulting in respiratory failure and death have occurred in cats, rabbits, monkeys, and dogs exposed intravenously to DDT (Philips and Gilman, 1946). Immunological effects include increases in gamma globulin, serum immunoglobulin and thymus weight. Rats had an increase in neurotransmitter levels in the brain and a decrease in learning and memory retrieval following a single intraperitoneal injection of DDT (Uppal *et al.*, 1983). Embryotoxicity and fetotoxicity including infertility have been reported in animals in the absence of maternal toxicity to DDT (ATSDR, 1988). DDT and its metabolites appear to produce chromosomal aberrations in animals. Evidence exists from animal studies to consider DDT, DDE, and DDD probable human carcinogens. Chronic exposure produced liver tumors in several strains of mice (Innes *et al.*, 1969; Thorpe and Walker, 1973; Tomatis, *et al.* 1972). Pulmonary adenomas and malignant lymphomas occurred in mice from exposure to DDT (Kashyap *et al.*, 1977; Shabad *et al.*, 1973).

### **Toxicological Criteria**

#### **Human Health Criteria**

The chronic oral reference dose (RfD) derived by EPA for DDT is 5.0E-4 mg/kg/day. The subchronic RfD is also 5.0E-04. The oral and inhalation potency factor is 3.4x10<sup>-1</sup> mg/kg/day for DDT and DDE, and 2.4x10<sup>-1</sup> mg/kg/day for DDD. OSHA has established a time weighted average (TWA) of 1 mg/m<sup>3</sup>. NIOSH has developed a TWA for skin at 0.5 mg/m<sup>3</sup> and the ACGIH has a TWA of 1 mg/m<sup>3</sup>. EPA has classified DDT, DDE, and DDD as B2 carcinogens. The oral CSF and unit risk factors for DDD, DDE, and DDT are as follows:

- DDD -- 2.4E-01 (mg/kg/day)<sup>-1</sup> and 6.9E-06 (µg/L)<sup>-1</sup>, respectively
- DDE -- 3.4E-01 (mg/kg/day)<sup>-1</sup> and 9.7E-06 (µg/L)<sup>-1</sup>, respectively
- DDT -- 3.4E-01 (mg/kg/day)<sup>-1</sup> and 9.7E-06 (µg/L)<sup>-1</sup>, respectively

The USEPA has not established chronic oral RfD or subchronic RfD values for DDD or DDE at this time.

### References

- ATSDR. 1988. Toxicological Profile for p,p'-DDT, p,p'-DDE, and p,p'-DDD. Prepared by Clement Associates for Agency for Toxic Substances and Disease Registry, U.S. Public Health Service in collaboration with the U.S. Environmental Protection Agency.
- Agarwal N, Sanyal S, Khuller G, *et al.* 1978. Effect of acute administration of dichlorodiphenyl trichloroethane on certain enzymes of Rhesus monkey. *Indian J Med Res* 68:1001-1006.
- Bathe R, Ullmann L, Sachsse K, *et al.* 1976. Relationship between toxicity to fish and to mammals: A comparative study under defined laboratory conditions. *Proc Eur Soc Toxicol* 17:351-55. As cited in ATSDR 1988.
- Cameron G. 1945. Risks to man and animals from the use of 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT): with a note on the toxicology of benzene hexachlor Br. *Med. Bull* 3:233-235.
- De Waziers I, Azais V. 1987. Drug metabolizing enzyme activities in the liver and intestine of rats exposed to DDT: effects of Vitamin A status. *Arch Environ Contam Toxicol* 16:343-348.
- Fawcett S, King L, Bunyan P, *et al.* 1987. The metabolism of [14C]-DDT, [14C]-DDD, [14C]-DDE and [14C]-DDMU in rats and Japanese quail. *Xenobiotica* 17:525-538.
- Gold B, Brunk G. 1982. Metabolism of 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane and 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane in the mouse. *Chem-Biol Interact* 41:327-339.
- Gold B, Brunk G. 1983. Metabolism of 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane (DDT), 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane and 1-chloro-2,2-bis(p-chlorophenyl)ethane in the hamster. *Cancer Res* 43:2644-2647.
- Gold B, Brunk B. 1984. A mechanistic study of the metabolism of 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane (DDD) to 2,2-bis(p-chlorophenyl)acetic acid (DDA). *Biochem Pharmacol* 33:979-982.
- Hayes W, Dale W, Pirkle C. 1971. Evidence of safety of long-term, high, oral doses of DDT for man. *Arch Environ Health* 22:119.
- Hays W, ed. 1982. Chlorinated hydrocarbon insecticides. In: *Pesticides Studies in Man*. Baltimore: Williams and Wilkins. Pp. 186-195.
- Hill K, Robinson G. 1945. A fatal case of DDT poisoning in a child. *Br Med J* 2:845.
- Hsieh H. 1954. DDT intoxication in a family in Southern Taiwan. *Am Med Assoc Arch Ind Hyg* 10:344-346.
- Innes J, Ulland B, Valeria M, *et al.* 1969. Bioassay of pesticides and industrial chemicals for tumorigenicity in mice: a preliminary note. *JNCI* 42:1101.



- Jensen J, Cueto C, Dale W, *et al.* 1957. DDT metabolites in feces and bile of rats. *J Agric Food Chem* 5:919-925.
- Kashyap S, Nigam S, Karnik A, *et al.* 1977. Carcinogenicity of DDT (dichlorodiphenyl trichloroethane) in pure inbred Swiss mice. *Int J Cancer* 19:725-729.
- Laws E, Curley A, Biros F. 1967. Men with intensive occupational exposure to DDT. *Arch Environ Health* 15:766-75.
- Lichtenstein E, Schulz K. 1959. Persistence of some chlorinated hydrocarbon insecticides as influenced by soil types, rate of application and temperature. *J Econ Entomol* 52:124-131.
- Morgan D, Lin L, Saikaly H. 1980. Morbidity and mortality in workers occupationally exposed to pesticides. *Arch Environ Contam Toxicol* 9:349.
- Morgan D, Roan C. 1971. Absorption, storage and metabolic conversion of ingested DDT and DDT metabolites in man. *Arch Environ Health* 22:301.
- Neal P, Von Oettingen W, Smith W, *et al.* 1944. Toxicity and potential dangers of aerosols, mists, and dusting powders containing DDT. *Public Health Report* 117:1-32.
- Okey A, Page D. 1974. Acute toxicity of o,p'-DDT to mice. *Bull Environ Contam Toxicol* 11:359-363.
- Oliver B, Niimi A. 1985. Bioconcentration factors of some halogenated organics for rainbow trout: limitations in their use for prediction of environmental residues. *Environ Sci Tech* 19:842-849.
- Ortelle M. 1958. Study of men with prolonged intensive occupational exposure to Ddt. *Am Med Assoc Arch Ind Health* 18:433-440.
- Pasha S. 1981. Changes in hepatic microsomal enzymes due to Ddt, DDE and DDD feeding in CF-1 mice. *Indian J Med Res* 74:926-930.
- Philips F, Gilman A. 1946. Studies on the pharmacology of DDT (2,2 Bis-(parachlorophenyl)-1,1,1-trichloroethane). *J Pharmacol Exp Ther* 86:213-221.
- Rabello M, Becak W, Dealmeida W, *et al.* 1975. Cytogenetic study on individuals occupationally exposed to DDT. *Mutat Res* 28:449.
- Shabad L, Kolesnichenko T, Nikonova T. 1973. Transplacental and combined long-term effect of DDT in five generations of A-strain mice. *Int J Cancer* 11:688-693.
- Sleicher C, Hopcraft J. 1984. Persistence of pesticides in surface soil and relation to sublimation. *Environ Sci Technol* 18:514-518.
- Stewart D, Chisholm D. 1971. Long-term persistence of BHC, DDT and chlordane in a sandy loam soil. *Can J Soil Sci* 51:379-383.

- Thorpe E, Walker A. 1973. The toxicology of dieldrin. II. Comparative long-term oral toxicity studies in mice w/dieldrin, DDT, phenobarbitone, beta-BHC and alpha-BHC. Food Cosmet Toxicol 11:433-442.
- Tomatis L, Turusov V, Day N, *et al.* 1972. The effect of long-term exposure to DDT on CF-1 mice. Int J Cancer 10:489-506.
- Uppal R, Garg B, Ahmad A. 1984. Neurologic effects of Malathion and DDT. Indian Vet J 61:201-210.

## ***Toxicological Profile for Sulfate***

### **Introduction**

Sulfates are found in relatively high concentrations in natural waters. Their major source is sulfate compounds found in sediments; however, they are also found in wastes and in detergents.

Humans are normally exposed to sulfate from a variety of sources including food, drinking water, ambient air, consumer products, and occupational situations. Ingestion of waters containing sulfate represents the most important route of exposure (USEPA, 1985). A 1970 survey of 969 samples of drinking water found sulfate levels ranging from 1 mg/L to 770 mg/L with a mean of 46 mg/L (NAS, 1977).

### **Pharmacokinetics**

Sulfate ingested in low doses (i.e., not resulting in catharsis) undergoes approximately 90 percent absorption by the gastrointestinal tract. Large doses are incompletely absorbed (approximately 60 to 70 percent) resulting in diarrhea and catharsis (Krijgsheld *et al.*, 1979; Morris and Levey, 1983). Sulfate is readily excreted in the urine in the form of the free sulfate with renal tubular re-absorption being saturable (White *et al.*, 1973). No data exist which would indicate a potential for bioaccumulation of sulfate even after chronic ingestion at elevated levels (USEPA, 1985).

### **Bioaccumulation**

No data are available concerning the bioaccumulation of sulfate in aquatic organisms at this time.

### **Toxicological Effects--Human Effects**

#### **Acute/Chronic Effects of Exposure for Humans**

Sulfate exhibits low oral toxicity in humans with the only major toxic effects at elevated levels manifesting as catharsis and diarrhea. These effects are associated with the osmotic activity of sulfate in the gastrointestinal tract. This leads to fluid accumulation in the colon and ultimately, catharsis and diarrhea (USEPA, 1985). Such cathartic effects have been shown to be minimal with ingestion of 1,490 mg total sulfate per day (An *et al.*, 1967; Peterson *et al.*, 1951) which represents a LOAEL (lowest observable adverse effect level) in humans. Ingestion of sulfate from drinking water in amounts greater than 1,490 mg/day is unlikely due to the unpalatableness of water containing sulfate at levels above 600 to 750 mg/L (Moore, 1952).

Infants represent a particularly sensitive subgroup to the cathartic effects of sulfate. Levels ranging from 630 to 1,150 mg/L in water used for infant formula have resulted in gastroenteritis and diarrhea. Parents ingesting the same exhibited no adverse effects (Chien, *et al.*, 1968). Of particular concern in the infants was the danger of dehydration resulting from the fluid loss. Substitution of the water source with one containing less sulfate resulted in complete recovery.

Information regarding the dosages which cause laxative effects is limited to a few clinical case studies and surveys of populations whose drinking water contains elevated sulfate levels. Physiological reactions are variable. Infants seem to be a sensitive subpopulation. Adaptation to the effects of elevated sulfate levels occurs in adults who are continuously exposed. Adverse effects are usually manifested only if the sulfate level increases suddenly.

No data were found which would associate sulfate with dermal toxicity. Owing to its ionic character, dermal adsorption of sulfate is expected to be negligible.

There is also no evidence that exposure to sulfate causes any teratogenicity or long-term health effects, such as carcinogenicity or mutagenicity in humans even after chronic exposure to elevated levels (USEPA, 1985).

### **Toxicological Effects--Environmental Effects**

#### **Acute/Chronic Effects of Exposure for Terrestrial Wildlife**

No data are available concerning the toxicity of sulfate to animals at this time.

#### **Acute/Chronic Effects of Exposure for Aquatic Wildlife**

No data are available concerning the toxicity of sulfate to aquatic wildlife at this time.

### **Toxicological Criteria**

**Human Health Criteria**--No chronic oral RfD or oral CSF values are available for sulfate at this time. Sulfate is not classified by the USEPA as a carcinogen to humans. No chronic inhalation RfD or inhalation CSF values are available for sulfate at this time.

### **Environmental Criteria**

The only established environmental criteria are the USEPA Ambient Water Quality Criteria (AWQC). No federal acute or chronic AWQCs are available for sulfate at this time.

**White-Tailed Deer**--No critical ecological toxicity value is available for sulfate at this time.

**Small Mammal (Mouse/Squirrel)**--No critical ecological toxicity value is available for sulfate at this time.

**Crayfish/Frog**--No critical ecological toxicity value is available for sulfate at this time.

### **REFERENCES**

An, A.S., *et al.* 1967. "Outbreak of intestinal disorders due to high sulfate concentration in drinking water." Hyg. Sanit., 32:264-266 (as cited by USEPA, 1985).

Chien, L., *et al.* 1968. "Infantile gastroenteritis due to water with high sulfate content," *Can. Med. Assoc. J.*, 99:102-104 (as cited by USEPA, 1985).

Krijgsheld, K.R., *et al.* 1979. "Absorption, serum levels, and urinary excretion of inorganic sulfate after oral administration of sodium sulfate in the conscious rat," *Biochem. Biophys. Acta*, 586:492-500 (as cited by USEPA).

Moore, E.W., 1952. "Physiological effects of the consumption of saline drinking water. A progress report to the 16th meeting of the Subcommittee on Water Supply of the Committee on Sanitary Engineering and Environment." Washington, D.C.: National Academy of Sciences, Appendix B (as cited by USEPA, 1985).

Morris, M.E., and Levy, G. 1983. "Serum concentration and renal excretion by normal adults of inorganic sulfate after acetaminophen, ascorbic acid, or sodium sulfate." *Clin Pharmacol. Ther.*, 33:529-536 (as cited by USEPA, 1985).

National Academy of Sciences, *Drinking Water and Health*, National Research Council, Washington, D.C., 1977.

Peterson, N.L., 1951. "Sulfates in drinking water," *Official Bulletin N.D. Water Sewage Works*, 18:11 (as cited by USEPA, 1985).

USEPA, 1985. *Drinking Water Criteria Document for Sulfate*, ICAIR Life Systems, Inc., Cleveland, Ohio.

White, A., *et al.* 1973. *Principles of Biochemistry*, 5th Edition, New York: McGraw-Hill Book Co. (as cited by USEPA, 1985).

## **Army Toxicological Profiles**

**TOXICITY SUMMARY FOR  
BENZ[a]ANTHRACENE**

September 1992

Prepared By

Andrew Francis  
Chemical Hazard Evaluation Group  
Biomedical Environmental Information Analysis Section  
Health and Safety Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for

U.S. ARMY TOXIC AND  
HAZARDOUS MATERIALS AGENCY  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Environmental Branch, Technology Division  
U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY  
Aberdeen Proving Ground, Maryland 210-5401

## EXECUTIVE SUMMARY

Benz[a]anthracene, along with a number of other polycyclic aromatic hydrocarbons, are natural products produced by the incomplete combustion of organic material. The arrangement of the aromatic rings in the benz[a]anthracene molecule gives it a "bay region" often correlated with carcinogenic properties. In general, the bay-region polycyclic aromatic hydrocarbons and some of their metabolites are known to react with cellular macromolecules, including DNA, which may account for both their toxicity and carcinogenicity. The inducible mixed-function oxidase enzymes oxidize benz[a]anthracene to form metabolites with increased water solubility that can be efficiently excreted in the urine. A minor product of this oxidation, a bay-region diol epoxide, reacts readily with DNA and has been shown to be highly carcinogenic (U.S. EPA, 1980; 1984; Jerina, et al., 1977).

The toxic effects of benz[a]anthracene and similar polycyclic aromatic hydrocarbons are primarily directed toward tissues that contain proliferating cells. Animal studies indicate that exposure to bay-region polycyclic aromatic hydrocarbons can damage the hematopoietic system leading to progressive anemia as well as agranulocytosis (Robinson, et al., 1975; Cawein and Sydnor, 1968). The lymphoid system can also be affected resulting in lymphopenia. Toxic effects have been observed in the rapidly dividing cells of the intestinal epithelium, spermatogonia and resting spermatocytes in the testis and primary oocytes of the ovary (Philips et al., 1973; Mackenzie and Angevine, 1981; Kraup, 1970; Ford and Huggins, 1963; Mattison and Thorgeirsson, 1977; U.S. EPA, 1980; 1984). Most of these effects have occurred following both oral and parenteral exposure. Epithelial proliferation and cell hyperplasia in the respiratory tract have been reported following subchronic inhalation exposure (Reznik-Schuller and Mohr, 1974; Saffiotti et al., 1968). However, because of the lack of quantitative data, neither a reference dose nor a reference concentration have been derived (U.S. EPA, 1991).

The primary concern with benz[a]anthracene exposure is its potential carcinogenicity. There is no unequivocal, direct evidence of the carcinogenicity of the compound to humans, however, benz[a]anthracene and other known carcinogenic polycyclic aromatic hydrocarbons are components of coal tar, soot, coke oven emissions and tobacco smoke. There is adequate evidence of its carcinogenic properties in animals. Oral exposures of mice to benz[a]anthracene have resulted in hepatomas, pulmonary adenomas and forestomach papillomas (Klein, 1963; Bock and King, 1959; U.S. EPA, 1991). The EPA weight-of-evidence classification is: B2, probable human carcinogen, for both oral and inhalation exposure based on adequate animal evidence and no human evidence (U.S. EPA, 1991). A slope factor has not been derived specifically for benz[a]anthracene by the EPA (U.S. EPA, 1991). However, an oral slope factor of 7.3 (mg/kg/day)<sup>-1</sup> has been calculated for benzo[a]pyrene based on the incidence of stomach tumors in mice treated with benzo[a]pyrene (Neal and Rigdon, 1967; U.S. EPA, 1980; 1984; 1992a). A drinking water unit risk of 2.1E-4 (µg/L)<sup>-1</sup> has also been calculated for benzo[a]pyrene (U.S. EPA, 1992a). An inhalation slope factor of 6.1 (mg/kg/day)<sup>-1</sup> (U.S. EPA, 1992b) was calculated for benzo[a]pyrene based on the incidence of respiratory tumors in golden hamsters treated with benzo[a]pyrene (Thyssen et al., 1981; U.S. EPA, 1980; 1984). An inhalation unit risk of 1.7E-3 (µg/m<sup>3</sup>)<sup>-1</sup> has also been calculated for benzo[a]pyrene (U.S. EPA, 1992b).



## 1. INTRODUCTION

Benz[a]anthracene (CAS registry number 56-55-3) is a polycyclic aromatic hydrocarbon containing four aromatic rings two of which share carbons with only one other ring. It is soluble in alcohol, ether and benzene but practically insoluble in water (9.4 µg/kg @ 25°C) (U.S. EPA, 1984; Weast, 1987). There is no commercial application for benz[a]anthracene, however, it is a ubiquitous contaminant formed during the incomplete combustion of organic material. Benz[a]anthracene is found in various kinds of smoke and flue gases, tobacco smoke, tobacco smoke condensate, automobile exhaust, roasted coffee and in charcoal broiled, barbecued or smoked meats. It is also found in creosote, coal tar, petroleum asphalt, and a variety of foods, including vegetable oils and baker's yeast. It is an atmospheric contaminant near power plants and busy highways, and tends to bind to particulate matter in the atmosphere. The primary removal mechanism from the atmosphere is thought to be ozonolysis reactions, where the expected half-life is less than 1 day to several weeks dependent on the nature of the particulate matter to which it is adsorbed. Benz[a]anthracene is also adsorbed to soil particulates where it undergoes degradation by microorganisms. It can persist in the soil from days to years depending on the adsorbent and the microorganisms present. The water insolubility of benz[a]anthracene limits its movement through the soil (Sittig, 1985; Sax, 1981; U.S. EPA, 1984).

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

Animal studies have shown that polycyclic aromatic hydrocarbons in general and benz[a]anthracene in particular are absorbed from the gastrointestinal tract (Rees et al., 1971). Specific inhalation studies on benz[a]anthracene were not available, but polyaromatic hydrocarbons as a class are considered capable of crossing epithelial membranes. Studies with benzo[a]pyrene and pyrene have shown rapid pulmonary absorption by rats (Kotin et al., 1969; Vainio et al., 1976; Mitchell and Tu, 1979). Quantitative data on benz[a]anthracene absorption are not available for either the oral or inhalation routes.

### 2.2. DISTRIBUTION

Specific studies on the distribution of benz[a]anthracene in humans were not available. However, animal studies using related polycyclic aromatic hydrocarbons, chiefly benzo[a]pyrene, indicate that these compounds are distributed in a wide variety of body tissues, eventually becoming localized primarily in fatty tissues. Approximately 80 to 90% of the administered benzo[a]pyrene disappeared from the blood within 6 minutes following a single intravenous 10 µg injection. A rapid equilibrium was reached between the blood and liver. The half time for benzo[a]pyrene removal from the liver was about 10 minutes; however, the disappearance was biphasic with a rapid initial phase followed by a slower phase lasting 6 hours or longer. Removal from the brain was slower than from the liver with benzo[a]pyrene concentration increasing in fat tissues for over 6 hours (Schlede, et al., 1970a). The disappearance of benzo[a]pyrene from all tissues is accelerated by pretreatment with benzo[a]pyrene. This pretreatment induces microsomal enzyme activities that are involved in the oxidation and detoxification of polycyclic aromatic hydrocarbons (Schlede, et al., 1970b; U.S. EPA, 1980).

### 2.3. METABOLISM

The arrangement of the aromatic rings in the molecule creates what has been termed a "bay region" imparting certain properties to the polycyclic aromatic hydrocarbons. Benz[a]anthracene and other bay-region polycyclic aromatic hydrocarbons undergo oxidation by microsomal enzymes (cytochrome P-450 mixed-function oxidase system) to excretable metabolites. Unfortunately, some intermediary metabolites, chiefly the bay-region diol epoxides, can readily react with DNA and greatly increase carcinogenic activity. The benz[a]anthracene 3,4-

diol-epoxide is a very minor metabolite of benz[a]anthracene oxidation, which may account for its weak tumorigenic properties when compared to some other bay region polycyclic aromatic hydrocarbons (Levin, et al., 1984; Jerina, et al., 1977).

## **2.4. EXCRETION**

The oxidized products produced by the cytochrome P-450 mixed-function oxidase system exhibit increased reactivity and will undergo conjugation with intracellular molecules such as glutathione resulting in compounds that have increased solubility in water and can be excreted efficiently in the urine. Less soluble metabolites and the parent compound can be excreted through the hepatobiliary system in the feces. Prior exposure to a polycyclic aromatic hydrocarbon results in the induction of the mixed-function oxidase enzymes and greatly increases the rate of excretion by increasing the formation of water soluble metabolites (U.S. EPA, 1980).

## **3. NONCARCINOGENIC HEALTH EFFECTS**

### **3.1. ORAL EXPOSURES**

#### **3.1.1. Acute Toxicity**

##### **3.1.1.1. Human**

Direct evidence of acute toxicity resulting from oral exposure of humans to benz[a]anthracene is unavailable.

##### **3.1.1.2. Animal**

Specific studies on the acute oral toxicity of benz[a]anthracene in animals were not available, however, several effects are common to the polycyclic aromatic hydrocarbon class of compounds. Generally these compounds and their metabolites are most toxic to targets that contain rapidly proliferating cells. They are known to bind to proteins and nucleic acids and may interfere with the processes involved in cell growth and division (U.S. EPA, 1980). The hematopoietic and lymphoid systems are common targets, as well as the intestinal epithelium and the testis.

Single feedings of 112 or 133 mg dimethyl benz[a]anthracene/kg body weight of female rats resulted in severe depression of hematopoietic and lymphoid precursors. Since only the more rapidly proliferating cells were affected by benz[a]anthracene, the authors suggested inhibition of DNA replication was involved in the toxicologic response (Cawein and Sydnor, 1968; U.S. EPA, 1980). In another experiment, female rats given 300 mg dimethyl benz[a]anthracene/kg by gavage displayed injury to the intestinal epithelium and developed a progressive anemia. Mortality of rats was about 65% at this dose (Philips et al., 1973).

#### **3.1.2. Subchronic Toxicity**

##### **3.1.2.1. Human**

No relevant reports of human subchronic oral exposure to benz[a]anthracene were available.

##### **3.1.2.2. Animal**

Specific data on the toxic effects of subchronic exposure of animals to benz[a]anthracene were not available. Experiments with other polycyclic aromatic hydrocarbons indicate that subchronic and acute exposures result in

similar effects. Oral exposure of mice to 120 mg benzo[a]pyrene/kg body weight/day for 6 months resulted in severe aplastic anemia. The inducibility of the microsomal mixed-function oxidase enzymes was shown to influence survival. Poorly inducible mice (AKR/N mice, Ahd/Ahd type) died within 4 weeks, whereas the inducible mice survived for the 6 month period. This experiment demonstrates the detoxification of a polycyclic aromatic hydrocarbon by the mixed-function oxidase system (Robinson et al., 1975; U.S. EPA, 1984).

### **3.1.3. Chronic Toxicity**

#### **3.1.3.1. Human**

No relevant reports of human chronic oral exposure to benz[a]anthracene were available.

#### **3.1.3.2. Animal**

Chronic experiments designed to demonstrate the carcinogenic nature of polycyclic aromatic hydrocarbons were inadequate to determine non-carcinogenic effects (U.S. EPA, 1984).

### **3.1.4. Developmental and Reproductive Toxicity**

#### **3.1.4.1. Human**

Studies describing developmental and reproductive effects in humans following oral exposure to benz[a]anthracene were not available.

#### **3.1.4.2. Animal**

Specific data on developmental and reproductive toxicity resulting from exposure of animals to benz[a]anthracene were unavailable. However, studies using similar polycyclic aromatic hydrocarbons indicate that exposure to these compounds may result in reproductive effects. Rigdon and Rennels (1964) fed female rats 50 mg benzo[a]pyrene/kg/day for 3.5 months including the gestation period. Increased fetal mortality was seen in all 7 treated females. The treated dams did not show gross signs of toxicity, although failure to lactate resulted in the death of the only surviving offspring within 3 days of birth.

Decreased fertility and gonadal weights in both sexes were seen in the offspring of mice treated orally with 10 mg/kg/day benzo[a]pyrene during gestation. A dose of 40 mg/kg/day resulted in almost complete sterility. No effect on fetal body weight or survival of the pups was reported (Mackenzie and Angevine, 1981).

Kraup (1970) reported the destruction of small oocytes and the reduction of the numbers of growing and large oocytes following oral administration of dimethyl benz[a]anthracene to mice (U.S. EPA, 1980).

### **3.1.5. Reference Dose**

A reference dose for chronic or subchronic oral exposure to benz[a]anthracene is not available.

## **3.2. INHALATION EXPOSURES**

### **3.2.1. Acute Toxicity**

#### **3.2.1.1. Human**

Information on the acute toxicity resulting from the inhalation exposure of humans to benz[a]anthracene was unavailable.

### **3.2.1.2. Animal**

Information on the acute toxicity resulting from the inhalation exposure of animals to benz[a]anthracene was unavailable.

## **3.2.2. Subchronic Toxicity**

### **3.2.2.1. Human**

Information on the toxicity resulting from the subchronic inhalation exposure of humans to benz[a]anthracene was unavailable.

### **3.2.2.2. Animal**

Information on the toxicity resulting from the subchronic inhalation exposure of animals to benz[a]anthracene was unavailable. However, subchronic inhalation exposures of golden hamsters to other polycyclic aromatic hydrocarbons, including dimethyl benz[a]anthracene, benzo[a]pyrene, and dibenzo[a,i]pyrene, caused epithelial proliferation and cell hyperplasia in the respiratory tract (total weekly dose of benzo[a]pyrene was 0.63 mg). These effects are usually seen without marked inflammation or necrosis by the 11th week of exposure, and precede the development of respiratory tract tumors (Reznik-Schuller and Mohr, 1974; Saffiotti, et al., 1968; U.S. EPA 1980).

## **3.2.3. Chronic Toxicity**

### **3.2.3.1. Human**

Information on the toxicity resulting from the chronic inhalation exposure of humans to benz[a]anthracene was unavailable.

### **3.2.3.2. Animal**

Information on the toxicity resulting from the chronic inhalation exposure of animals to benz[a]anthracene was unavailable. Experiments utilizing the chronic exposure of animals to other polycyclic aromatic hydrocarbons were designed to study carcinogenesis and are not suitable for describing toxicity effects.

## **3.2.4. Developmental and Reproductive Toxicity**

### **3.2.4.1. Human**

No reports were available on developmental and reproductive effects in humans following inhalation exposure to benz[a]anthracene.

### **3.2.4.2. Animal**

No reports were available on developmental and reproductive effects in animals following inhalation exposure to benz[a]anthracene.

## **3.2.5. Reference Concentration**

A reference concentration for chronic or subchronic inhalation exposure to benz[a]anthracene is not available.

### 3.3. OTHER ROUTES OF EXPOSURE

#### 3.3.1. Acute Toxicity

##### 3.3.1.1. Human

Direct evidence of acute toxicity resulting from exposure of humans to benz[a]anthracene by other routes is unavailable.

##### 3.3.1.2. Animal

Single injections of polycyclic aromatic hydrocarbons have demonstrated the toxic effects of these compounds on rapidly proliferating cells. An intraperitoneal injection of 3-methylcholanthrene (0.3 to 1.0 mg) in 12 hour to 9 day-old mice resulted in severe degeneration of the thymus, reduction in weight of the spleen and mesenteric lymph nodes, degeneration of bone marrow cells, and retardation of thyroid gland development. Increased mortality was observed with newborn mice after treatment (Yasuhira, 1964).

Philips et al. (1973) gave male rats a single intravenous injection of 50 mg/kg of 7,12-dimethylbenz[a]anthracene. The targets that were affected included damage to the intestinal epithelium, atrophy of the hematopoietic elements, decreased weight of lymphoid organs, agranulocytosis, lymphopenia, and progressive anemia. A similar experiment demonstrated a decreased [14C]-labeled thymidine incorporation into the DNA in the cells of small and large intestine, spleen, bone marrow, cervical lymph nodes, thymus, and testis. This inhibition, which was as high as 90%, was seen 6 hours after treatment and indicated a reduction in DNA synthesis in these organs, which normally contain rapidly dividing cells

#### 3.3.2. Subchronic Toxicity

##### 3.3.2.1. Human

Subchronic or chronic dermal exposure of workers to materials such as coal tar, mineral oil, and petroleum waxes containing benz[a]anthracene and other polycyclic aromatic hydrocarbons resulted in the development of dermatitis and hyperkeratoses (Hueper, 1963; NAS, 1972).

##### 3.3.2.2. Animal

Topical application of benz[a]anthracene and other polycyclic aromatic hydrocarbons to mouse skin results in the destruction of sebaceous glands, hyperplasia, hyperkeratosis, and ulceration of the skin. The sebaceous glands are the most sensitive structures to polycyclic hydrocarbons. A correlation exists between the carcinogenic activity of benz[a]anthracene and its toxicity toward the sebaceous glands (Bock, 1964).

Weekly subcutaneous injections of dibenz[a,h]anthracene, benz[a]anthracene and anthracene in mice resulted in dilated lymph sinuses and a decrease of lymphoid cells within 40 weeks. The lymph glands contained increased numbers of reticulum (stem) cells and an accumulation of iron. Decreased spleen weight was observed in the mice receiving dibenz[a,h]anthracene (Hoch-Ligeti, 1941).

Lasnitzki and Woodhouse (1944) studied the effects of subcutaneous injections of dibenz[a,h]anthracene, benzo[a]pyrene, 3-methylcholanthrene, and anthracene on lymph nodes in rats. Injections were given 5 times weekly for several weeks and, with the exception of anthracene, resulted in extravascular red blood cells in the lymph spaces and the presence of large pigmented cells.

### **3.3.3. Chronic Toxicity**

#### **3.3.3.1. Human**

Subchronic or chronic exposure of the skin to polycyclic aromatic hydrocarbon-containing materials can cause dermatitis in humans (see section 3.3.2.1.).

#### **3.3.3.2. Animal**

Chronic exposure experiments using various routes were designed to examine cancer end points and are not generally useful as toxicity studies. The qualitative results, however, generally reflect those observed for the effects from single or subchronic exposures to polycyclic aromatic hydrocarbons (U.S. EPA, 1980).

### **3.3.4. Developmental and Reproductive Toxicity**

#### **3.3.4.1. Human**

Information on the developmental and reproductive toxicity of benz[a]anthracene in humans by other routes of exposure was unavailable.

#### **3.3.4.2. Animal**

Single intravenous injections of 0.5 to 2.0 mg dimethyl benz[a]anthracene in 25-day old rats or injections of 5.0 mg in 60-day old rats resulted in degenerative changes in the testis 38 to 40 days after treatment. These lesions included the destruction of spermatogonia and resting spermatocytes (Ford and Huggins, 1963). In a similar experiment, the destruction of primary oocytes in mice was also seen after injection of 3-methylcholanthrene. The effect in this experiment was correlated with the ability of the mice to induce the microsomal mixed-function oxidase enzymes following treatment (Mattison and Thorgeirsson, 1977).

## **3.4. TARGET ORGANS/CRITICAL EFFECTS**

### **3.4.1. Oral Exposures**

#### **3.4.1.1. Primary Target(s)**

1. Hematopoietic system: Animal studies have shown atrophy of the hematopoietic elements leading to progressive anemia and agranulocytosis after exposure to polycyclic aromatic hydrocarbons.
2. Lymphoid system: Shrinkage of lymphoid organs and lymphopenia have been noted in animals exposed to polycyclic aromatic hydrocarbons.
3. Intestinal epithelium: Damage to the rapidly growing epithelial cells of animals has been observed following exposure to polycyclic aromatic hydrocarbons.
4. Testis or ovary: Destruction of the spermatogonia and resting spermatocytes in males and the primary oocytes in females following exposure to polycyclic aromatic hydrocarbons.

#### **3.4.1.2. Other Target(s)**

1. Fetus: Increased fetal mortality has been observed in animal experiments with benzo[a]pyrene exposure during gestation.

### **3.4.2. Inhalation Exposures**

#### **3.4.2.1. Primary Targets**

1. Respiratory tract: Animal experiments have shown epithelial proliferation and cell hyperplasia following subchronic exposure to polycyclic aromatic hydrocarbons. This effect may be a preneoplastic lesion.

## **4. CARCINOGENICITY**

### **4.1. ORAL EXPOSURES**

#### **4.1.1. Human**

Data relating human oral exposure to benz[a]anthracene and subsequent cancer development was not available. Benz[a]anthracene is a component of mixtures that have been associated with human cancers such as coal tar, soots, coke oven emissions, automobile exhaust, and cigarette smoke (U.S.EPA, 1980; 1984).

#### **4.1.2. Animal**

Klein (1963) treated male mice with 3% benz[a]anthracene in Methocel-aerosol O.T. by gavage 3 times/week for 5 weeks. Tumors were evaluated on days 437-444 and 547 after the initiation of treatment. An increased incidence of pulmonary adenomas and hepatomas was noted at all observation times when compared with controls. The incidence of pulmonary adenomas reached 95% and the incidence of hepatoma reached 100% after 547 days. Bock and King (1959) administered 8 or 16 gavage treatments of benz[a]anthracene to mice at 3-7 day intervals over a 16-month period. They found forestomach papillomas in the treated groups (2/27) and none in the control group (0/16).

Treatment of Swiss mice with benzo[a]pyrene, a related polycyclic aromatic hydrocarbon, also resulted in stomach tumors. Mice were fed doses ranging between 1 and 250 ppm in the diet for 110 days. The appearance of squamous cell papillomas and carcinomas was roughly dose dependent. The cancer incidences observed were 0/289 for the control, 1/23 for 2.6 mg/kg/day, 1/40 for 5.2 mg/kg/day, 4/40 for 5.85 mg/kg/day, and 19/23 for 13.0 mg/kg/day (Neal and Rigdon, 1967).

### **4.2. INHALATION EXPOSURES**

#### **4.2.1. Human**

Data on human inhalation exposure to benz[a]anthracene and subsequent cancer development was not available. Benz[a]anthracene is a component of mixtures containing other polycyclic aromatic hydrocarbons that have been associated with human cancers such as coal tar, soots, coke oven emissions, automobile exhaust, and cigarette smoke (U.S. EPA, 1980; 1984).

#### **4.2.2. Animal**

Data on inhalation exposure of animals to benz[a]anthracene and subsequent cancer development were not available. There are studies, however, that show tumor development following inhalation of related polycyclic aromatic hydrocarbons. Golden hamsters exposed by inhalation to 9.5 mg/m<sup>3</sup> benzo[a]pyrene for 4.5 hours/day for 10 weeks, followed by 3 hours/day for up to 675 days, developed tumors of the nasal cavity, larynx, trachea and pharynx. The high dose also caused tumors of the upper digestive tract (Thyssen et al., 1981).

### **4.3. OTHER ROUTES OF EXPOSURE**

#### **4.3.1. Human**

Data relating other routes of exposure to benz[a]anthracene and subsequent cancer development were not available. Benz[a]anthracene is a component of mixtures that have been associated with human cancers such as coal tar, soots, coke oven emissions, automobile exhaust, and cigarette smoke (U.S. EPA, 1980; 1984).

#### **4.3.2. Animal**

Intraperitoneal injections of mice with benz[a]anthracene in dimethylsulfoxide on days 1, 8, and 15 of age (total dose of 638 µg/mouse) resulted in liver adenomas and carcinomas in male mice (31/39 total tumors treated, 25/39 adenomas, 2/28 total controls) and pulmonary adenomas in female mice (6/32 treated, 0/32 controls) 1 year after exposure (Wislocki et al., 1986).

Subcutaneous injection of mice with benz[a]anthracene resulted in sarcomas at the site of injection 9 months following treatment. Injection of 5.0 mg produced a sarcoma incidence of 34% with no tumors seen in controls (Steiner and Edgecomb, 1952).

A number of studies have shown benz[a]anthracene to have initiating activity and to act as a complete carcinogen in skin painting assays in several strains of mice (IARC, 1973; U.S. EPA, 1991b). Levin et al. (1984) tested the tumor-initiating activity of benz[a]anthracene and a number of its metabolic products in a mouse skin painting assay. A single dose of 0.4 or 2.5 µmole of benz[a]anthracene followed by 25 weeks of promotion with 12-O-tetradecanoylphorbol-13-acetate resulted in skin tumor incidence of 7% for the controls, 14% for 0.4 µmole, and 36% for 2.5 µmole.

### **4.4. EPA WEIGHT-OF-EVIDENCE**

#### **4.4.1. Oral**

CLASSIFICATION: Group B2 -- Probable Human Carcinogen (U.S. EPA, 1991b).

BASIS: Based on no human data and sufficient data from animal experiments. Benz[a]anthracene has been shown to produce tumors in mice exposed by gavage; topical application; and intraperitoneal, subcutaneous or intramuscular injection (U.S. EPA 1991).

#### **4.4.2. Inhalation**

CLASSIFICATION: Group B2 -- Probable Human Carcinogen (U.S. EPA, 1991b).

BASIS: Based on no human data and sufficient data from animal experiments. Benz[a]anthracene has been shown to produce tumors in mice exposed by gavage; topical application; and intraperitoneal, subcutaneous or intramuscular injection (U.S. EPA 1991). A related bay-region polycyclic aromatic hydrocarbon, benzo[a]pyrene, has been shown to cause respiratory tract tumors in golden hamsters when given by inhalation exposure (Thyssen et al., 1981).



## 4.5. CARCINOGENICITY SLOPE FACTORS

### 4.5.1. Oral

An oral slope factor has not been calculated specifically for benz[a]anthracene (U.S. EPA, 1991).

Benzo[a]pyrene:

SLOPE FACTOR: 7.3 (mg/kg/day)-1 (U.S. EPA, 1980; 1984; 1992a).

DRINKING WATER UNIT RISK: 2.1E-4 (µg/L)-1 (U.S. EPA, 1992a)

VERIFICATION DATE: 07/01/92

PRINCIPAL STUDY: Neal and Rigdon (1967).

COMMENTS: This slope factor was calculated by the EPA, (1984) from data obtained from experiments using benzo[a]pyrene and was based on the incidence of stomach tumors in mice. This slope factor was applied to protect humans from the carcinogenic effects of polycyclic aromatic hydrocarbons as a chemical class. It is not currently available on IRIS for specific use with benz[a]anthracene.

### 4.5.2. Inhalation

An inhalation slope factor has not been calculated specifically for benz[a]anthracene (U.S. EPA, 1991).

Benzo[a]pyrene:

SLOPE FACTOR: 6.1 (mg/kg/day)-1 (U.S. EPA, 1992b)

INHALATION UNIT RISK: 1.7E-3 (µg/m3) -1 (U.S. EPA 1992b).

VERIFICATION DATE: Not verified.

PRINCIPAL STUDY: Thyssen et al. (1981).

COMMENTS: This slope factor was calculated by the EPA, (1984) from data obtained from experiments using benzo[a]pyrene and was based on the incidence of respiratory tumors in golden hamsters. This slope factor was applied to protect humans from the carcinogenic effects of polycyclic aromatic hydrocarbons as a chemical class. It is not currently available on IRIS for specific use with benz[a]anthracene.

## 5. REFERENCES

- Bock, F.G. 1964. Early effects of hydrocarbons on mammalian skin. *Progr. Exp. Tumor Res.* 4: 126.
- Bock, F.G. and D.W. King. 1959. A study of the sensitivity of the mouse forestomach toward certain polycyclic hydrocarbons. *J. Natl. Cancer Inst.* 23: 833-839.
- Cawein, M.J. and K.L. Sydnor. 1968. Suppression of cellular activity in the reticuloendothelial system of the rat by 7,12-dimethylbenz[a]anthracene. *Cancer Res.* 28: 320.
- Ford, E. and C. Huggins. 1963. Selective destruction in testis induced by 7,12-dimethylbenz[a]anthracene. *J. Exp. Med.* 118: 27.
- Hoch-Ligeti, C. 1941. Studies on the changes in the lymphoid tissues of mice treated with carcinogenic and non-carcinogenic hydrocarbons. *Cancer Res.* 1: 484.
- Hueper, W.C. 1963. Chemically induced skin cancers in man. *Natl. Cancer Inst. Monograph.* 10: 377.
- IARC (International Agency for Research on Cancer). 1973. Certain Polycyclic Aromatic Hydrocarbons and Heterocyclic Compounds. *Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Polynuclear Aromatic Compounds.* Vol. 3. Lyon, France.

Jerina, D.M., R. Lehr, M. Schaefer-Ridder, H. Yagi, J.M. Karle, D.R. Thakker, A.W. Wood, A.Y.H. Lu, D. Ryan, S. West, W. Levin and A.H. Conney. 1977. Bay-region epoxides of dihydrodiols: A concept explaining the mutagenic and carcinogenic activity of benzo[a]pyrene and benzo[a]anthracene. in: *Origins of Human Cancer*. Cold Spring Harbor Laboratory. pp. 639-657.

Klein, M. 1963. Susceptibility of strain B6AF1/J hybrid infant mice to tumorigenesis with 1,2-benzanthracene, deoxycholic acid, and 3-methylcholanthrene. *Cancer Res.* 23: 1701-1707.

Kotin, p., et al. 1969. Distribution, retention, and elimination of 14C-3,4-benzpyrene after administration to mice and rats. *J. Natl. Cancer Inst.* 23: 541.

Kraup, T. 1970. Oocyte survival in the mouse ovary after treatment with 9,10-dimethyl-1,2-benz[a]anthracene. *J. Endocrinol.* 46: 483.

Lasnitzki, A. and D.L. Woodhouse. 1944. The effect of 1,2,5,6-dibenzanthracene on the lymph nodes of the rat. *J. Anat.* 78: 121.

Levin, W., R.L. Chang, A.W. Wood, H. Yagi, D.R. Thakker, D.M. Jerina and A. H. Conney. 1984. High Stereoselectivity among the optical isomers of the diastereomeric bay-region diol-epoxides of benz[a]anthracene in the expression of tumorigenic activity in murine tumor models. *Cancer Res.* 44: 929-933.

MacKenzie, K.M. and D.M. Angevine. 1981. Infertility in mice exposed in utero to benzo[a]pyrene. *Biol. Reprod.* 24: 183-191.

Mattison, D.R. and S.S. Thorgeirsson. 1977. Ovarian metabolism of polycyclic aromatic hydrocarbons and associated ototoxicity in the mouse. *Gynecol. Invest.* 8: 11.

Mitchell, C.E. and K. W. Tu. 1979. Distribution, retention and elimination of pyrene in rats after inhalation. *J. Toxicol. Environ. Health.* 5: 1171-1179.

National Academy of Sciences. 1972. Biological effects of atmospheric pollutants: Particulate polycyclic organic matter. Washington, D.C.

Neal, J. and R.H. Rigdon. 1967. Gastric tumors in mice fed benzo[a]pyrene: A quantitative study. *Tex. Rep. Biol. Med.* 25: 553.

Philips, F.S., et al. 1973. In vivo cytotoxicity of polycyclic hydrocarbons. In: *Pharmacology and the Future of Man*. Proc. 5th Intl. Congr. Pharmacol., 1972, San Francisco. 2: 75.

Rees, E.O., et al. 1971. A study of the mechanism of intestinal absorption of benzo[a]pyrene. *Biochem. Biophys. Acta.* 225: 96.

Reznik-Schuller, H. and U. Mohr. 1974. Investigations on the carcinogenic burden by air pollution in man. IX. Early pathological alterations of the bronchial epithelium in Syrian golden hamsters after intratracheal instillation of benzo[a]pyrene. *Zbl. Bakt. Hyg., I. Abt. Orig. B.* 159: 493.

Rigdon, R.H. and E.G. Rennels. 1964. Effect of feeding benzpyrene on reproduction in the rat. *Experientia.* 20: 224-226.

Robinson, J.R., J.S. Felton, R.C. Levitt, S.S. Thorgiersson and D.W. Nebert. 1975. Relationship between "aromatic hydrocarbon responsiveness" and the survival times in mice treated with various drugs and environmental compounds. *Mol. Pharmacol.* 11: 850-865.

Saffiotti, U., et al. 1968. A method for the experimental induction of bronchogenic carcinoma. *Cancer Res.* 28: 104.

Sax, N.I. 1981. *Cancer Causing Chemicals*. Van Nostrand Reinhold, New York, p. 299.

Schlede, E., et al. 1970b. Stimulatory effect of benzo[a]pyrene and phenobarbital pretreatment on the biliary excretion of benzo[a]pyrene metabolites in the rat. *Cancer Res.* 30: 2898.

Schlede, E., et al. 1970a. Effect of enzyme induction on the metabolism and tissue distribution of benzo[a]pyrene. *Cancer Res.* 30: 2893.

Sittig, M. 1985. *Handbook of Toxic and Hazardous Chemicals and Carcinogens*, Second Edition. Noyes Publications, Park Ridge, New Jersey, pp.109-110.

Steiner, P.E. and J.H. Edgecomb. 1952. Carcinogenicity of 1,2-benzanthracene. *Cancer Res.* 12: 657-659.

Thyssen, F., J. Althoff, G. Kimmerle and U. Mohr. 1981. Inhalation studies with Benzo[a]pyrene in Syrian golden hamsters. *J. Natl Cancer Inst.* 66: 575-577.

U.S. EPA. 1980. *Water Quality Criteria Document for Polynuclear Aromatic Hydrocarbons*. Prepared by the Office of Research and Development, Environmental Criteria And Assessment Office, Cincinnati, OH for the Office of Water Regulations and Standards, Washington, DC.

U.S. EPA. 1984. *Health Effects Assessment for Polycyclic Aromatic Hydrocarbons*. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington, DC. E.P.A./540/1-86-013.

U.S. EPA. 1991. *Integrated Risk Information System (IRIS). Health Risk Assessment for Benz[a]anthracene*. OnLine. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH.

U.S. EPA. 1992a. *Integrated Risk Information System (IRIS). Health Risk Assessment for Benzo[a]pyrene*. OnLine. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH.

U.S. EPA. 1992b. *Health Effects Assessment Summary Tables*, Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington, DC.

Vainio, H., et al. 1976. The fate of intratracheally installed benzo[a]pyrene in the isolated perfused rat lung of both control and 20-methylcholanthrene pretreated rats. *Res. Comm. Chem. Pathol. Pharmacol.* 13: 259.

Weast, R.C., J.A. Melvin and W.H. Beyer (ed). 1987. *CRC Handbook of Chemistry and Physics*. CRC Press, Inc., Boca Raton, Florida, pp C-105.

Wislocki, P.G., E.S. Bagan, A.Y.H. Lu, et al. 1986. Tumorigenicity of nitrated derivatives of pyrene, benz[a]anthracene, chrysene and benzo[a]pyrene in the newborn mouse assay. *Carcinogenesis.* 7: 1317-1322.

Yasuhira, K. 1964. Damage to the thymus and other lymphoid tissues from 3-methylcholanthrene, and subsequent thymoma production, in mice. *Cancer Res.* 24: 558.

**TOXICITY SUMMARY FOR  
BENZO[a]PYRENE**

December 1994

Prepared by:

Rosmarie A. Faust, Ph.D.  
Chemical Hazard Evaluation Group  
Biomedical and Environmental Information Analysis Section  
Health Sciences Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for:

U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Technology Demonstration and Transfer Branch  
Environmental Technology Division  
U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

---

\*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400

## EXECUTIVE SUMMARY

Benzo[a]pyrene is a polycyclic aromatic hydrocarbon (PAH) that can be derived from coal tar. Occurring ubiquitously in products of incomplete combustion of fossil fuels, benzo[a]pyrene has been identified in ambient air, surface water, drinking water, and waste water, and in char-broiled foods (IARC, 1983). Benzo[a]pyrene is primarily released to the air and removed from the atmosphere by photochemical oxidation and dry deposition to land or water. Biodegradation is the most important transformation process in soil or sediment (ATSDR, 1990).

Benzo[a]pyrene is readily absorbed following inhalation, oral, and dermal routes of administration (ATSDR, 1990). Following inhalation exposure, benzo[a]pyrene is rapidly distributed to several tissues in rats (Sun et al., 1982; Weyand and Bevan, 1986). The metabolism of benzo[a]pyrene is complex and includes the formation of a proposed ultimate carcinogen, benzo[a]pyrene 7,8 diol-9,10-epoxide (IARC, 1983). The major route of excretion is hepatobiliary followed by elimination in the feces (U.S. EPA, 1991).

No data are available on the systemic (non-carcinogenic) effects of benzo[a]pyrene in humans. In mice, genetic differences appear to influence the toxicity of benzo[a]pyrene. Subchronic dietary administration of 120 mg/kg benzo[a]pyrene for up to 180 days resulted in decreased survival due to hematopoietic effects (bone marrow depression) in a "nonresponsive" strain of mice (i.e., a strain whose cytochrome P-450 mediated enzyme activity is not induced as a consequence of PAH exposure). No adverse effects were noted in "responsive" mice (i.e., a strain capable of inducing increased cytochrome P-450 mediated enzyme activity as a consequence of PAH exposure) (Robinson et al., 1975). Immunosuppression has been reported in mice administered daily intraperitoneal injections of 40 or 160 mg/kg of benzo[a]pyrene for 2 weeks, with more pronounced effects apparent in "nonresponsive" mice (Blanton et al., 1986; White et al., 1985). In utero exposure to benzo[a]pyrene has produced adverse developmental/reproductive effects in mice. Dietary administration of doses as low as 10 mg/kg during gestation caused reduced fertility and reproductive capacity in offspring (Mackenzie and Angevine, 1981) and treatment by gavage with 120 mg/kg/day during gestation caused stillbirths, resorptions, and malformations (Legraverend et al., 1984). Similar effects have been reported in intraperitoneal injection studies (ATSDR, 1990).

Neither a reference dose (RfD) nor a reference concentration (RfC) has been derived for benzo[a]pyrene.

Numerous epidemiologic studies have shown a clear association between exposure to various mixtures of PAHs containing benzo[a]pyrene (e.g., coke oven emissions, roofing tar emissions, and cigarette smoke) and increased risk of lung cancer and other cancers. However, each of the mixtures also contained other potentially carcinogenic PAHs; thus, it is not possible to evaluate the contribution of benzo[a]pyrene to the carcinogenicity of these mixtures (IARC, 1983; U.S. EPA, 1991). There is an extensive data base for the carcinogenicity of benzo[a]pyrene in experimental animals. Dietary administration of benzo[a]pyrene has produced papillomas and carcinomas of the forestomach in mice (Neal and Rigdon, 1967) and treatment by gavage has produced mammary tumors in rats (McCormick et al., 1981) and pulmonary adenomas in mice (Wattenberg and Leong, 1970). Exposure by inhalation and intratracheal instillation has resulted in benign and malignant tumors of the respiratory and upper digestive tracts of hamsters (Ketkar et al., 1978; Thyssen et al., 1981). Numerous topical application studies have shown that benzo[a]pyrene induces skin tumors in several species, although mice appear to be the most sensitive species. Benzo[a]pyrene is a complete carcinogen and also an initiator of skin tumors (IARC, 1973; U.S. EPA, 1991). Benzo[a]pyrene has also been reported to induce tumors in animals when administered by other routes (intravenous, intraperitoneal, subcutaneous, intrapulmonary, transplacental).

Based on U.S. EPA guidelines, benzo[a]pyrene was assigned to weight-of-evidence group B2, probable human carcinogen. For oral exposure, the slope factor and unit risk are  $7.3\text{E}+0$  (mg/kg/day)<sup>-1</sup> and  $2.1\text{E}-4$  ( $\mu\text{g/L}$ )<sup>-1</sup>, respectively (U.S. EPA, 1994).

## 1. INTRODUCTION

Benzo[a]pyrene (CAS Reg. No. 50-32-8), also known as 1,4-benzo[a]pyrene (BaP), is a polycyclic aromatic hydrocarbon (PAH) with a chemical formula of  $C_{20}H_{12}$  and a molecular weight of 252.3. It exists as yellowish plates and needles, has a boiling point of 310-312°C at 10 mm Hg (Budavari et al., 1989), a melting point of 178°C, and a density of 1.35 (U.S. EPA, 1991). Benzo[a]pyrene is practically insoluble in water, but is soluble in benzene, toluene, xylene, and is sparingly soluble in alcohol and methanol (Budavari et al., 1989). It has a vapor pressure of  $5.0 \times 10^{-1}$  torr and a log octanol/water coefficient of 6.04 (U.S. EPA, 1991).

There is no commercial production or use of benzo[a]pyrene. It occurs ubiquitously in products of incomplete combustion and in fossil fuels. It has been identified in surface water, tap water, rain water, ground water, waste water, and sewage sludge (U.S. EPA, 1991). Benzo[a]pyrene is primarily released to the air and removed from the atmosphere by photochemical oxidation and dry deposition to land or water. Biodegradation is the primary transformation process in soil or sediment (ATSDR, 1990). The estimated half-lives for benzo[a]pyrene are <1-6 days in the atmosphere, <1-8 hours in water, 5-10 years in sediment, and >14-16 months in soil (for complete degradation) (U.S. EPA, 1984). Benzo[a]pyrene is one of a number of PAHs on EPA's priority pollutant list (ATSDR, 1990).

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

Benzo[a]pyrene is readily absorbed by the oral, inhalation, and dermal routes of exposure (ATSDR, 1990). Rats given benzo[a]pyrene in starch solution by gavage (100 mg) or in the diet (250 mg) absorbed 40% or 60%, respectively, of the administered compound (Chang, 1943). The absorption of benzo[a]pyrene from the gastrointestinal tract of mice and cats is enhanced when it is solubilized in vehicles possessing both lipophilic and hydrophilic properties (Ekwall et al., 1951). Once benzo[a]pyrene has entered the small intestine, it is solubilized by bile salts and absorbed (Ermala et al., 1951).

In rats exposed by inhalation to 1  $\mu\text{g/L}$  radiolabeled benzo[a]pyrene for 30 minutes, monitoring of excretion over a 2-week period showed nearly complete recovery of radioactivity (predominantly in feces), indicating nearly complete absorption (Sun et al., 1982).

Under in vitro conditions, 3% of an applied dose of benzo[a]pyrene permeated human skin after 24 hours. When tested in several animal species, the permeation was highest in the mouse (10%) and lowest in the guinea pig (0.1%) (Kao et al., 1985). Following topical application of radiolabeled benzo[a]pyrene to the skin of mice, Heidelberger and Weiss (1951) recovered most of the radioactivity in the feces within 16 days, indicating significant absorption of benzo[a]pyrene through the skin.

### 2.2. DISTRIBUTION

According to Rees et al. (1971), 10-20% of an intragastric dose of benzo[a]pyrene (10 mg) entered the thoracic lymph duct in rats (levels in other tissues were not determined). Other data concerning the tissue distribution of benzo[a]pyrene following oral exposure were not available.

In rats exposed by inhalation, distribution of absorbed benzo[a]pyrene is rapid, with highest levels found in the liver, esophagus, small intestine, and blood 30 minutes after exposure (Sun et al., 1982). Five minutes after intratracheal instillation of benzo[a]pyrene to rats, the percentages of the administered dose in tissues were: lungs (59.5%), carcass (14.4%), liver (12.5%); blood (3.9%); and intestines (1.9%). At

60 minutes, the percentages were: lungs (15.4%), carcass (27.1%), liver (15.8%), blood (1.6%), and intestines (9.9%) (Weyand and Bevan, 1986).

Topical administration of <sup>14</sup>C-benzo[a]pyrene in benzene to the shaved backs of mice was followed by a biphasic disappearance of radioactivity from the application site, with half-lives of 40 and 104 hours (Heidelberger and Weiss, 1951).

Benzo[a]pyrene can readily cross the placenta following oral, intravenous, or subcutaneous administration. This observation is consistent with the observed toxicity in the fetuses and offspring of maternally exposed rodents (IARC, 1983; ATSDR, 1990).

### **2.3. METABOLISM**

The metabolism of benzo[a]pyrene has been extensively studied in the literature and only the most important pathways will be presented in this summary. As outlined in IARC (1983), benzo[a]pyrene is metabolized initially by the microsomal cytochrome P-450 monooxygenase system to several arene oxides, which may rearrange spontaneously to phenols, undergo hydration to the corresponding trans-dihydrodiols, or react covalently with glutathione, either spontaneously or in a reaction catalyzed by glutathione-S-transferases. One of the phenolic metabolites, 6-hydroxybenzo[a]pyrene, is further oxidized to the 1,6-, 3,6-, or 6,12-quinones. The phenols, quinones, and dihydrodiols can be detoxified by conjugation to glucuronides and sulfate esters and the quinones can also form glutathione conjugates. In addition to conjugation, the dihydrodiols undergo further oxidative metabolism. Benzo[a]pyrene 7,8-dihydrodiol is in part oxidized to the 7,8-diol-9,10-epoxide, a compound considered to be the ultimate carcinogenic metabolite of benzo[a]pyrene.

### **2.4. EXCRETION**

Hepatobiliary excretion and elimination in the feces is the primary route in which metabolites of benzo[a]pyrene are excreted (U.S. EPA, 1991). Two weeks following inhalation exposure to radiolabeled benzo[a]pyrene for 30 minutes, most of the radioactivity was recovered in the feces of rats (Sun et al., 1982). Similarly, essentially all of the radioactivity was recovered in the feces of mice that had been treated topically with radiolabeled benzo[a]pyrene (Heidelberger and Weiss, 1951). Kotin et al. (1959) reported that approximately 75% of a subcutaneously injected dose of benzo[a]pyrene was recovered in the feces of mice within 6 days of injection, while only 12% was eliminated in the urine. In rats, 39% of an intravenous dose was found in the bile at 3 hours, and as much as 96% by 14 hours. Less than 1% of recovered benzo[a]pyrene in the bile was unmetabolized. In rats with bile duct cannulation, 3-4% of the dose was recovered in the urine, while intact rats had a urinary excretion of 7-14%, suggesting that enterohepatic circulation of metabolites. There was no evidence that benzo[a]pyrene is eliminated via expired air.

## **3. NONCARCINOGENIC HEALTH EFFECTS**

### **3.1. ORAL EXPOSURES**

#### **3.1.1. Acute Toxicity**

Information on the acute oral toxicity of benzo[a]pyrene in humans or animals was not available.

#### **3.1.2. Subchronic Toxicity**

##### **3.1.2.1. Human**

Information on the subchronic oral toxicity of benzo[a]pyrene in humans was not available.

### **3.1.2.2. Animal**

Genetic differences appear to influence the oral toxicity of benzo[a]pyrene in mice. Robinson et al. (1975) investigated the effects of oral administration of benzo[a]pyrene in several strains of mice, classified as "responsive" (those capable of producing increased levels of cytochrome P-450 mediated enzymes as a consequence of PAH exposure) or "nonresponsive" (those not highly responsive to producing increased levels of cytochrome P-450 mediated enzymes as a consequence of PAH exposure). Following dietary administration of 120 mg/kg of benzo[a]pyrene for up to 180 days, survival of all "nonresponsive" mice was shortened. Death appeared to be due to bone marrow depression (aplastic anemia, pancytopenia). The "responsive" mice remained healthy for at least six months. The authors concluded that decreased survival in "nonresponsive" mice was associated with a single gene difference in PAH responsiveness.

### **3.1.3. Chronic Toxicity**

Information on the chronic oral toxicity of benzo[a]pyrene in humans or animals was not available.

### **3.1.4. Developmental and Reproductive Toxicity**

#### **3.1.4.1. Human**

Information on the developmental and reproductive toxicity of benzo[a]pyrene in humans following oral exposure was not available.

#### **3.1.4.2. Animal**

No reproductive or developmental toxicity was observed in male or female White Swiss mice fed diets containing 0, 250, 500, or 1000 mg/kg benzo[a]pyrene over various time periods during mating, gestation, and lactation (Rigdon and Neal, 1965). However, Mackenzie and Angevine (1981) reported that administration of 10 mg/kg to CD-1 mice by gavage during gestation produced decreased gonadal weights, and reduced fertility and reproductive capacity in the offspring. Higher doses (40 mg/kg) caused almost complete sterility in both sexes of offspring.

Legraverend et al. (1984) investigated the effect of genetic differences in benzo[a]pyrene metabolism on the reproductive or developmental toxicity in "responsive" and "nonresponsive" mice (benzo[a]pyrene metabolism occurs more readily in the "responsive" genotypes).

Pregnant mice were fed 120 mg/kg/day on days 2 through 10 of gestation. Treatment with benzo[a]pyrene resulted in stillbirths, resorptions, and malformations in both genotypes of mice; however, the incidence of these effects was higher among "nonresponsive" embryos than among "responsive" embryos. The study suggests that it is benzo[a]pyrene and not a metabolite which is responsible for the noted adverse effects.

### **3.1.5. Reference Dose**

An oral reference dose (RfD) for benzo[a]pyrene has not been derived.

## **3.2. INHALATION EXPOSURES**

### **3.2.1. Acute Toxicity**

Information on the acute toxicity of benzo[a]pyrene in humans or animals following inhalation exposure was not available.



### **3.2.2. Subchronic Toxicity**

Information on the subchronic toxicity of benzo[a]pyrene in humans or animals following inhalation exposure was not available.

### **3.2.3. Chronic Toxicity**

Information on the chronic toxicity of benzo[a]pyrene in humans or animals following inhalation exposure was not available.

### **3.2.4. Developmental and Reproductive Toxicity**

Information on the developmental and reproductive toxicity of benzo[a]pyrene in humans or animals following inhalation exposure was not available.

### **3.2.5. Reference Concentration**

An inhalation reference concentration (RfC) for benzo[a]pyrene has not been derived.

## **3.3. OTHER ROUTES OF EXPOSURE**

### **3.3.1. Acute Toxicity**

#### **3.3.1.1. Human**

Information on the acute toxicity of benzo[a]pyrene in humans by other routes of exposure was not available.

#### **3.3.1.2. Animal**

The intraperitoneal (i.p.) LD50 for the mouse is 232 mg/kg (Salamone, 1981) and the subcutaneous (s.c.) LD50 for the rat is 50 mg/kg (RTECS, 1994). Reduced survival was reported in "responsive" mice administered a single i.p. injection of 500 mg/kg benzo[a]pyrene (Robinson et al., 1975). Subcutaneous injections of benzo[a]pyrene (5, 20, or 40 mg/kg) caused a dose-related suppression of both T-cell independent and T-cell dependent antigens in mice (White and Holsapple, 1984). Wojdani et al. (1984) injected two strains of mice with tumor target cells; this treatment was followed by i.p. injections of 0, 0.5, 5, or 50 mg/kg of benzo[a]pyrene. At the two higher doses, there were significant decreases in lymphocytes binding to target cells or killing target cells. The investigators indicated that lymphocyte-mediated immunity may be inhibited by benzo[a]pyrene and that this immunosuppressive effect may contribute to its carcinogenicity.

### **3.3.2. Subchronic Toxicity**

#### **3.3.2.1. Human**

Information on the subchronic toxicity of benzo[a]pyrene by other routes of exposure in humans was not available.

#### **3.3.2.2. Animal**

Immunotoxic effects as a consequence of benzo[a]pyrene have been studied by a number of investigators. For example, a 60% suppression of antibody response was reported in B6C3F1 mice (a highly

"responsive" strain) administered 14 daily s.c. injections of 160  $\mu$ mol/kg benzo[a]pyrene. In DBA/2 mice (a strain not highly "responsive") subjected to the same dosing protocol, immunosuppression was more pronounced (White et al., 1985). Daily s.c. injections of 40 mg/kg benzo[a]pyrene for 14 days resulted in a 98% depression of the T-cell-dependent antibody response in B6C3F1 mice. Polyclonal antibody responses were reduced 50 to 66% following benzo[a]pyrene (Blanton et al., 1986).

### **3.3.3. Chronic Toxicity**

Information on the chronic toxicity of benzo[a]pyrene by other routes of exposure in humans or animals was not available.

### **3.3.4. Developmental and Reproductive Toxicity**

#### **3.3.4.1. Human**

Information on the developmental or reproductive toxicity of benzo[a]pyrene by other routes of exposure in humans was not available.

#### **3.3.4.2. Animal**

Adverse developmental/reproductive effects were observed in several injection studies with benzo[a]pyrene. These studies are reviewed in ATSDR (1990), but experimental details were not provided. Intraperitoneal administration of benzo[a]pyrene to mice has resulted in stillbirths, resorptions, and malformations; decreases in follicular growth and corpora lutea; and in testicular changes. Subcutaneous injections of benzo[a]pyrene produced increased resorptions in rats and direct embryonal injection led to decreased fetal survival in mice.

## **3.4. TARGET ORGANS/CRITICAL EFFECTS**

### **3.4.1. Oral Exposures**

#### **3.4.1.1. Primary Target Organs**

1. Hematopoietic system: Subchronic oral exposure produced bone marrow depression (aplastic anemia and pancytopenia) and ultimately death in "nonresponsive" mice.
2. Reproduction/development: Exposure during gestation of mice produced decreased gonadal weights, reduced fertility, and sterility in offspring. Stillbirths, resorptions, and malformations were seen in "responsive" and "nonresponsive" mice; however, the incidence of these effects was higher in "nonresponsive" mice.

#### **3.4.1.2. Other Target Organs**

Other target organs for oral exposure were not identified.

### **3.4.2. Inhalation Exposures**

Target organs for inhalation exposure to benzo[a]pyrene were not identified.

### **3.4.3. Other Routes of Exposure**

#### **3.4.3.1. Primary Target Organs**

1. Immune system: Subcutaneous injections of benzo[a]pyrene administered over a 2-week period caused depressed antibody responses in mice.
2. Reproduction/development: Intraperitoneal injections of benzo[a]pyrene has resulted in stillbirths, resorptions, malformations, decreased follicular growth and corpora lutes, and in testicular changes in mice. Subcutaneous injections produced increased resorptions in rats.

#### **3.4.3.2. Other Target Organs**

Other target organs for other routes of exposure were not identified.

## **4. CARCINOGENICITY**

### **4.1. ORAL EXPOSURES**

#### **4.1.1. Human**

Information on the carcinogenicity of benzo[a]pyrene in humans following oral exposure was not available.

#### **4.1.2. Animal**

In a study by Brune et al. (1981), male and female Sprague-Dawley rats were fed 0.15 mg/kg every 9th day or 5 times/week for life. The incidence of tumors of the forestomach, esophagus, and larynx (combined) was 5% for controls and for rats fed benzo[a]pyrene every 9th day, and 16% for rats fed benzo[a]pyrene 5 times/week. Administration of a single 50-mg dose of benzo[a]pyrene or of 8 weekly doses of 6.25 mg by gavage induced mammary tumors in LEW/Mai rats (McCormick et al., 1981). The incidence of mammary carcinomas after 90 weeks was 77% for the single exposure and 67% for the multiple exposures. Mammary tumors were observed in 30% of controls. Huggins and Yang (1962) reported that a single oral dose of 100 mg benzo[a]pyrene administered by gavage induced mammary tumors in 8/9 female Sprague-Dawley rats.

Neal and Rigdon (1967) fed male and female CFW-Swiss mice a diet containing 1 to 250 ppm benzo[a]pyrene for up to 197 days. No tumors were found in the control group and in groups treated with 1, 10, or 30 ppm. However, forestomach papillomas and carcinomas developed at dietary concentrations of  $\geq 40$  ppm. The authors indicated that the tumor incidence was related to both the concentration and the number of doses administered. Female mice administered 200 or 300 ppm benzo[a]pyrene in the diet for a relatively short time (12 weeks) developed tumors of the forestomach (Triolo et al., 1977). Pulmonary adenomas developed in A/HeJ mice treated by gavage with two daily doses of 3 mg benzo[a]pyrene at 2-week intervals (Wattenberg and Leong, 1970). The pulmonary tumor count increased from 0.3 tumors/mouse in controls to 16.6 tumors/mouse in the treated group at 30 weeks of age.

### **4.2. INHALATION EXPOSURES**

#### **4.2.1. Human**

Numerous epidemiologic studies have shown a clear association between inhalation exposure to various mixtures containing PAHs (e.g., coke oven emissions, roofing tar emissions, and cigarette smoke) and

increased risk of lung cancer and other cancers. Each of these mixtures contained benzo[a]pyrene as well as other carcinogenic PAHs and other potentially carcinogenic chemicals; thus, it is not possible to evaluate the contribution of benzo[a]pyrene to the carcinogenicity of these mixtures (IARC, 1983; U.S. EPA, 1991).

#### 4.2.2. Animal

Thyssen et al. (1981) exposed Syrian hamsters to benzo[a]pyrene at concentrations of 0, 2.2, 9.5, or 46.5 mg/m<sup>3</sup>, 4.5 hours/day for 10 days and then 3 hours/day for up to 675 days. No treatment-related tumors were observed in hamsters exposed to 2.2 mg/m<sup>3</sup> or in controls. Hamsters exposed to 9.5 mg/m<sup>3</sup> developed papillomas and squamous cell carcinomas located primarily in the nasal cavity, larynx, trachea, and pharynx. In addition to respiratory tract tumors, hamsters exposed to the highest concentration also developed tumors of the upper digestive tract.

Intratracheal administration of benzo[a]pyrene also induced neoplasms of the respiratory tract in male and female Syrian hamsters. Weekly intratracheal administration of benzo[a]pyrene (total doses 18.2 or 36.4 mg/animal) for 52 weeks produced a dose-related increase of tracheal papillomas/carcinomas and lung adenomas. Similar effects were reported following weekly intratracheal administration of doses ranging from 0.1 to 1 mg up to 40 weeks, but the response was not clearly dose-related (Ketkar et al., 1978).

### 4.3. OTHER ROUTES OF EXPOSURE

#### 4.3.1. Human

Human tumorigenicity has been reported in a number of studies as a result of dermal exposure to complex mixtures of PAHs containing benzo[a]pyrene. An early report (Pott, 1775) described scrotal cancer in chimney sweeps. More recently, skin cancer has occurred in workers exposed to shale oil (Purde and Etlin, 1980) and creosote (Lenson, 1956). However, the contribution of benzo[a]pyrene to the carcinogenicity of these PAH mixtures is uncertain.

In an experimental study, epidermal changes (erythema, pigmentation, and desquamation) were reported following daily applications of a 1% solution of benzo[a]pyrene to the skin of humans over a 4-month period. Although reversible and benign, these changes were thought to represent early stages of neoplastic proliferation (Cottini and Mazzone, 1939). It should be noted that benzo[a]pyrene was applied as a solution in benzene and no benzene control was evaluated. Similar epithelial changes were reported in humans accidentally exposed to benzo[a]pyrene (U.S. EPA, 1984).

#### 4.3.2. Animal

Benzo[a]pyrene is among the most potent and best documented skin carcinogens and is commonly used as a positive control in skin application assays of other chemicals. Benzo[a]pyrene has been shown to cause skin tumors in mice, rats, rabbits, and guinea pigs, although mice appear to be the most sensitive species. It is both an initiator and complete carcinogen in mouse skin (IARC, 1973; U.S. EPA, 1991).

Wynder and Hoffmann (1959) applied 0.001, 0.005, or 0.01% benzo[a]pyrene in acetone to the backs of female Swiss mice three times weekly for life. For the three dose groups, the incidence of skin papillomas was 95, 100, or 85%, respectively, and the incidence of skin carcinomas was 4, 86, or 95%, respectively. Data for a solvent control group were not provided. In initiation/promotion experiments, Hoffmann and Wynder (1966) applied 10 doses of benzo[a]pyrene in dioxane (total dose 0.25 mg) every two days to the skin of mice. This treatment was followed by application of 2.5% croton oil in acetone. Skin papillomas developed in 80% of treated animals and in 7% of controls (receiving croton oil alone).

The modifying effects of solvents on the carcinogenicity of benzo[a]pyrene have been demonstrated in several studies. For example, Bingham and Falk (1969) treated C3H/He mice topically with different

concentrations of benzo[a]pyrene in either n-dodecane or a n-dodecane/decalin mixture three times weekly for 50 weeks. When n-dodecane/decalin was used as solvent, malignant skin tumors appeared in 5/24 mice treated with 0.00002% benzo[a]pyrene and the tumor incidence increased at higher concentrations. With decalin alone as solvent, malignant skin tumors developed in 5/12 mice treated with 0.02%, but none were seen at lower concentrations. Other topical application studies with mice demonstrated synergistic effects of cigarette smoke condensates on skin tumor induction (IARC, 1973).

Benzo[a]pyrene has been shown to produce tumors at various sites by other modes of administration. A 94% incidence of lung adenomas was reported in newborn mice injected i.p. with 280  $\mu\text{g}$ /mouse of benzo[a]pyrene (Busby et al., 1984). Newborn rats treated with a single i.p. injection of 0.59  $\mu\text{mol}$  benzo[a]pyrene/kg and observed for life developed hepatic tumors. The tumor incidence was 37% for males and 57% for females (Peraino et al., 1984). Several studies reported injection site tumors in mice, rats, guinea pigs, hamsters, and some primates administered s.c. injections of benzo[a]pyrene (U.S. EPA, 1994). In addition to injection site sarcomas, newborn mice administered benzo[a]pyrene by s.c. injection developed hepatomas or lung adenomas (U.S. EPA, 1991; IARC, 1973). Benzo[a]pyrene has also been reported to induce tumors when administered by the intravenous and transplacental route; by implantation in the stomach wall, renal parenchyma, and brain; by injection in the renal pelvis; and by vaginal painting (U.S. EPA, 1994).

#### 4.4 EPA WEIGHT-OF-EVIDENCE

Classification -- B2, probable human carcinogen (U.S. EPA, 1994).

Basis -- Human data specifically linking benzo[a]pyrene to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating benzo[a]pyrene to be carcinogenic by numerous routes (U.S. EPA, 1994).

Note: The carcinogenicity risk assessment for benzo[a]pyrene may change in the near future pending further review by EPA.

#### 4.5. CARCINOGENICITY SLOPE FACTORS

##### 4.5.1. Oral

SLOPE FACTOR:	7.3E+0 (mg/kg/day)-1 (U.S. EPA, 1994)
UNIT RISK:	2.1E-4 ( $\mu\text{g}/\text{L}$ )-1
PRINCIPAL STUDIES:	Brune et al., 1981; Neal and Rigdon, 1967; Rabstein et al., 1973 (historical control data)

COMMENT: The slope factor, the geometric mean of four calculated slope factors [range 4.5E+0 to 11.7E+0 (mg/kg/day)-1], was derived using multiple data sets from different studies employing more than one sex, strain, and species. EPA considered the data less than optimal, but acceptable.

##### 4.5.2. Inhalation

An inhalation slope factor has not been calculated.

### 5. REFERENCES

ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Benzo(a)pyrene. Prepared by ICF-Clement, under Contract No. 68-02-4235. ATSDR/TP-88-05.

Bingham, E. and H.L. Falk. 1969. Environmental carcinogens. The modifying effect of cocarcinogens on the threshold response. *Arch. Environ. Health* 19: 779-783.

Blanton, R.H., M. Lyte, M.J. Myers and P.H. Bick. 1986. Immunomodulation by polycyclic aromatic hydrocarbons in mice and murine cells. *Cancer Res.* 46: 2735-2739.

Brune, H., R.P. Deutsch-Wenzel, M. Habs, et al. 1981. Investigation of the tumorigenic response to benzo(a)pyrene in aqueous caffeine solution applied orally to Sprague-Dawley rats. *J. Cancer Res. Clin. Oncol.* 102: 153-157.

Budavari, S., M.J. O'Neil and A. Smith. 1989. *The Merck Index*. Merck & Co., Rahway, NJ, p. 172.

Busby, W.F., Jr., M.E. Goldman, P.M. Newberne and G.N. Wogan. 1984. Tumorigenicity of fluoranthene in a newborn mouse lung adenoma bioassay. *Carcinogenesis* 5: 1311-1316.

Chang, L.H. 1943. The fecal excretion of polycyclic hydrocarbons following their administration to the rat. *J. Biol. Chem.* 151: 93-99. (Cited in U.S. EPA, 1984; U.S. EPA, 1991)

Cottini, G.B. and G.B. Mazzone. 1939. The effects of 3,4-benzpyrene on human skin. *Am. J. Cancer* 37: 186-195. (Cited in U.S. EPA, 1991)

Ekwall, P., P. Ermala, K. Setälä and L. Sjöblom. 1951. Gastric absorption of 3,4-benzpyrene. II. The significance of the solvent for the penetration of 3,4-benzpyrene into the stomach wall. *Cancer Res.* 11: 758-763.

Ermala, P., K. Setälä and P. Ekwall. 1951. Gastric absorption of 3,4-benzpyrene. I. The effect of physiologic processes on absorption. *Cancer Res.* 11: 753-757.

Heidelberger, C. and S.M. Weiss. 1951. The distribution of radioactivity in mice following administration of 3,4-benzpyrene-5-C14 and 1,2,5,6-dibenzanthracene-9,10-C14. *Cancer Res.* 11: 885-891.

Hoffmann, D. and E.L. Wynder. 1966. [Beitrag zur carcinogenen Wirkung von Dibenzopyrenen.] *Z. Krebsforsch.* 68: 137-149.

Huggins, C. and N.C. Yang. 1962. Induction and extinction of mammary cancer. *Science* 137: 257-262.

IARC (International Agency for Research on Cancer). 1973. Benzo(a)pyrene. In: *IARC Monographs on the Evaluation of Carcinogenic Risk of the Chemical to Man. Certain Polycyclic Aromatic Hydrocarbons and Heterocyclic Compounds*, Vol. 3. World Health Organization, Lyon, France, pp. 91-136.

IARC (International Agency for Research on Cancer). 1983. Benzo[a]pyrene. In: *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Polynuclear Aromatic Compounds. Part 1. Chemical, Environmental and Experimental Data*, Vol. 32. World Health Organization, Lyon, France, pp. 33-224.

Kao, J., F.K. Patterson and J. Hall. 1985. Skin penetration and metabolism of topically applied chemicals in six mammalian species, including man: An in vitro study with benzo[a]pyrene and testosterone. *Toxicol. Appl. Pharmacol.* 81: 502-516.

Ketkar, M., G. Reznik, P. Schneider and U. Mohr. 1978. Investigations on the carcinogenic burden by air pollution in man. Intratracheal instillation studies with benzo[a]pyrene in bovine albumin in Syrian hamsters. *Cancer Lett.* 4: 235-239.

- Kotin, P., H.L. Falk and R. Busser. 1959. Distribution, retention, and elimination of 14C-3,4-benzpyrene after administration to mice and rats. *J. Natl. Cancer Inst.* 23: 541-555.
- Legraverend C., T.M. Guenther and D.W. Nebert. 1984. Importance of the route of administration for genetic differences in benzo[a]pyrene-induced in utero toxicity and teratogenicity. *Teratology* 29: 35-47.
- Lenson, N. 1956. Multiple cutaneous carcinoma after creosote exposure. *N. Engl. J. Med.* 254: 520-523.
- MacKenzie, K.M. and D.M. Angevine. 1981. Infertility in mice exposed in utero to benzo[a]pyrene. *Biol. Reprod.* 24: 183-191. (Cited in IARC, 1983)
- McCormick, D.L., F.J. Burns and R.E. Albert. 1981. Inhibition of benzo[a]pyrene-induced mammary carcinogenesis by retinyl acetate. *J. Natl. Cancer Inst.* 66: 559-564.
- Neal, J. and R.H. Rigdon. 1967. Gastric tumors in mice fed benzo[a]pyrene: A quantitative study. *Tex. Rep. Biol. Med.* 25: 553-557. (Cited in U.S. EPA, 1994)
- Peraino, C., E.F. Staffeldt, B.A. Carnes, et al. 1984. Characterization of histochemically detectable altered hepatocyte foci and their relationship to hepatic tumorigenesis in rats treated once with diethylnitrosamine or benzo[a]pyrene within one day after birth. *Cancer Res.* 44: 3340-3347.
- Pott, P. 1775. Surgical observations relative to the cancer of the scrotum. London. Reprinted in *Natl. Cancer Inst. Monog.* 10: 7-13 (1973). (Cited in ATSDR, 1990)
- Purde, M. and S. Etlin. 1980. Cancer cases among workers in the Estonia oil shale processing industry. In: *Health Implications of New Energy Technologies*, W.N. Rom and V.E. Archer, Eds. Ann Arbor Science, Ann Arbor, MI, pp. 527-528. (Cited in ATSDR, 1990)
- Rabstein, L.S., R.L. Peters and G.J. Spahn. 1973. Spontaneous tumors and pathologic lesions in SWR/J mice. *J. Natl. Cancer Inst.* 50: 751-758. (Cited in U.S. EPA, 1994)
- Rees, E.D., P. Mandelstam, J.Q. Lowry and H. Lipscomb. 1971. A study of the mechanism of intestinal absorption of benzo(a)pyrene. *Biochem. Biophys. Acta* 225: 96-107.
- Rigdon, R.H. and J. Neal. 1965. Effects of feeding benzo[a]pyrene on fertility, embryos, and young mice. *J. Natl. Cancer Inst.* 34: 297-305.
- Robinson, J.R., J.S. Felton, R.C. Levitt, et al. 1975. Relationship between "aromatic hydrocarbon responsiveness" and the survival times in mice treated with various drugs and environmental compounds. *Mol. Pharmacol.* 11: 850-865. (Cited in ATSDR, 1990; IARC, 1983)
- RTECS (Registry of Toxic Effects of Chemicals). 1994. MEDLARS Online Information Retrieval System, National Library of Medicine. Retrieved September, 1994.
- Salamone, M.F. 1981. Toxicity of 41 carcinogens and noncarcinogenic analogs. In: de Serres, F.J. and J. Ashby, Eds. *Evaluation of Short-term Tests for Carcinogens. Report of the International Corroborative Program. Progress in Mutation Research*, Vol. 1. Elsevier-North-Holland, pp. 682-685.
- Sun, J.D., R.K. Wolff and G.M. Kanapilly. 1982. Deposition, retention, and biological fate of inhaled benzo[a]pyrene adsorbed onto ultrafine particles and as a pure aerosol. *Toxicol. Appl. Pharmacol.* 65: 231-244.

Thyssen, J., J. Althoff, G. Kimmerle and U. Mohr. 1981. Inhalation studies with benzo[a]pyrene in Syrian golden hamsters. *J. Natl. Cancer Inst.* 66: 575-577.

Triolo, A.J., G.E. Aponte and D.L. Herr. 1977. Induction of aryl hydrocarbon hydroxylase and forestomach tumors by benzo(a)pyrene. *Cancer Res.* 37: 3018-3021.

U.S. EPA (U.S. Environmental Protection Agency). 1984. Health Effects Assessment for Benzo(a)pyrene. Prepared by the Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Emergency and Remedial Response. EPA/CIN-HO22.

U.S. EPA (U.S. Environmental Protection Agency). 1991. Drinking Water Criteria for Polycyclic Aromatic Hydrocarbons (PAHs). Prepared by the Environmental Criteria and Assessment, Office, Office of Health and Environmental Assessment, Cincinnati, OH, for the Office of Water, Washington, DC. ECAO-CIN-D010.

U.S. EPA (U.S. Environmental Protection Agency). 1994. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH.

Wattenberg, L.W. and J.L. Leong. 1970. Inhibition of the carcinogenic action of benzo[a]pyrene by flavones. *Cancer Res.* 30: 1922-1925.

Weyand, E.H. and D.R. Bevan. 1986. Benzo(a)pyrene disposition and metabolism in rats following intratracheal instillation. *Cancer Res.* 46: 5655-5661.

White, K.L. and M.P. Holsapple. 1984. Direct suppression of in vitro antibody production by mouse spleen cells by the carcinogen benzo(a)pyrene but not by the noncarcinogenic congener benzo(e)pyrene. *Cancer Res.* 44: 3388-3393.

White, K.L., H.H. Lysy and M.P. Holsapple. 1985. Immunosuppression by polycyclic aromatic hydrocarbons. A structure-activity relationship in B6C3F1 and DBA/2 mice. *Immunopharmacology* 9: 155-164. (Cited in U.S. EPA, 1991)

Wojdani, A., M. Attarzadeh, G. Wolde-Tsadik and L.J. Alfred. 1984. Immunocytotoxicity effects of polycyclic aromatic hydrocarbons on mouse lymphocytes. *Toxicology* 31: 181-189.

Wynder, E.L. and D. Hoffmann. 1959. A study of tobacco carcinogenesis. VII. The role of higher polycyclic hydrocarbons. *Cancer* 12: 1079-1086.



**TOXICITY SUMMARY FOR  
BENZO[b]FLUORANTHENE**

May 1994

Prepared by:

Rosmarie A. Faust, Ph.D.  
Chemical Hazard Evaluation Group  
Biomedical and Environmental Information Analysis Section  
Health Sciences Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for:

U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Environmental Branch, Technology Division  
U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

## EXECUTIVE SUMMARY

Benzo[*b*]fluoranthene, a crystalline solid with a chemical formula of  $C_{20}H_{12}$  and a molecular weight of 252.32 (Lide, 1991), is a polycyclic aromatic hydrocarbon (PAH) with one five-membered ring and four six-membered rings. There is no commercial production or known use of this compound (IARC, 1983). Benzo[*b*]fluoranthene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion. It has been detected in mainstream cigarette smoke, urban air, gasoline engine exhaust, emissions from burning of coal and from oil-fired heating, broiled and smoked food, and oils and margarine (IARC, 1983); and in soils, groundwater, and surface waters at hazardous waste sites (ATSDR, 1990).

No absorption data were available for benzo[*b*]fluoranthene; however, by analogy to structurally-related PAHs, primarily benzo[*a*]pyrene, it would be expected to be absorbed from the gastrointestinal tract, lungs, and skin (U.S. EPA, 1991). Major metabolites of benzo[*b*]fluoranthene formed *in vitro* in rat liver include dihydrodiols and monohydroxy derivatives (Amin et al., 1982) and monohydroxy derivatives in mouse epidermis (Geddie et al., 1987).

No data were found concerning the acute, subchronic, chronic, developmental, or reproductive toxicity of benzo[*b*]fluoranthene. No data were available for the derivation of an oral reference dose (RfD) or inhalation reference concentration (RfC) (U.S. EPA, 1994).

No long-term oral or inhalation bioassays were available to assess the carcinogenicity of benzo[*b*]fluoranthene. Benzo[*b*]fluoranthene was tested for carcinogenicity in dermal application, lung implantation, subcutaneous (s.c.) injection, and intraperitoneal (i.p.) injection studies. Dermal applications of 0.01-0.5% solutions of benzo[*b*]fluoranthene for life produced a high incidence of skin papillomas and carcinomas in mice (Wynder and Hoffmann, 1959). In initiation-promotion assays, the compound was active as an initiator of skin carcinogenesis in mice (LaVoie et al., 1982; Amin et al., 1985). Sarcomas and carcinomas of the lungs and thorax were seen in rats receiving single lung implants of 0.1-1 mg benzo[*b*]fluoranthene (Deutsch-Wenzel et al., 1983). Newborn mice receiving 0.5  $\mu$ mol benzo[*b*]fluoranthene via i.p. injection developed liver and lung tumors (LaVoie et al., 1987) and mice administered three s.c. injections of 0.6 mg benzo[*b*]fluoranthene developed injection site sarcomas (Lacassagne et al., 1963).

Based on no human data and sufficient evidence for carcinogenicity in animals, EPA has assigned a weight-of-evidence classification of B2, probable human carcinogen, to benzo[*b*]fluoranthene (U.S. EPA, 1994).

## 1. INTRODUCTION

Benzo[*b*]fluoranthene (CAS Reg. No. 205-99-2), also known as benz(e)acephenanthrylene, 3,4-benz(e)acephenanthrylene, 2,3-benzofluoranthene, 3,4-benzofluoranthene, and benzo(e)fluoranthene (IARC, 1983) is a polycyclic aromatic hydrocarbon (PAH) with one five-membered ring and four six-membered rings. It is a crystalline solid with a chemical formula of  $C_{20}H_{12}$ , a molecular weight of 252.32, and a melting point of 168°C (Lide, 1991). Benzo[*b*]fluoranthene is virtually insoluble in water and is slightly soluble in benzene and acetone (IARC, 1983). It has a vapor pressure of  $10^{-11}$  to  $10^{-6}$  torr at 20°C, an octanol/water partition coefficient of  $1.1 \times 10^6$ , and a Henry's Law constant of  $1.22 \times 10^{-5}$  (ATSDR, 1990).

There is no commercial production or known use of this compound (IARC, 1983). Benzo[*b*]fluoranthene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion. It has been detected in mainstream cigarette smoke, urban air, gasoline engine exhaust, emissions from burning of coal and from oil-fired heating, broiled and smoked food, and oils and margarine (IARC, 1973); as well as in soils, groundwater, and surface waters at hazardous waste sites (ATSDR, 1990). Benzo[*b*]fluoranthene is one of a number of PAHs on EPA's priority pollutant list (ATSDR, 1990).

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

Data regarding the gastrointestinal or pulmonary absorption of benzo[*b*]fluoranthene in humans or animals were not available. However, data from structurally-related PAHs, primarily benzo[*a*]pyrene, suggest that benzo[*b*]fluoranthene would be absorbed from the gastrointestinal tract, lungs, and skin (U.S. EPA, 1991).

### 2.2. DISTRIBUTION

No human or animal data were available concerning the tissue distribution of benzo[*b*]fluoranthene.

### 2.3. METABOLISM

Amin et al. (1982) investigated the *in vitro* metabolism of benzo[*b*]fluoranthene by rat liver microsomes and identified 5- and 6-hydroxybenzo[*b*]fluoranthene and 4- or 7-hydroxybenzo[*b*]fluoranthene as major metabolites. The principal dihydrodiol metabolite formed was *trans*-11,12-dihydro-11,12-dihydroxybenzo[*b*]fluoranthene. Geddie et al. (1987) investigated the metabolism of benzo[*b*]fluoranthene in mouse epidermis. Following dermal application of benzo[*b*]fluoranthene, 4-, 5-, and 6-hydroxybenzo[*b*]fluoranthene were identified as major metabolites. Also detected were sulfate and glucuronide conjugates of these hydroxy compounds.

## **2.4. EXCRETION**

No human or animal data were available concerning the excretion of benzo[b]fluoranthene.

## **3. NONCARCINOGENIC HEALTH EFFECTS**

### **3.1. ORAL EXPOSURES**

Information on the acute, subchronic, chronic, developmental, or reproductive oral toxicity of benzo[b]fluoranthene in humans or animals was not available. Because of a lack of toxicity data, an oral reference dose (RfD) for benzo[b]fluoranthene has not been derived (U.S. EPA, 1994).

### **3.2. INHALATION EXPOSURES**

Information on the acute, subchronic, chronic, developmental, or reproductive toxicity of benzo[b]fluoranthene in humans or animals following inhalation exposure was not available. Because of a lack of toxicity data, an inhalation reference concentration (RfC) for benzo[b]fluoranthene has not been derived (U.S. EPA, 1994).

### **3.3. OTHER ROUTES OF EXPOSURE**

Information on the acute, subchronic, chronic, developmental, or reproductive toxicity of benzo[b]fluoranthene in humans or animals by other routes of exposure was not available.

### **3.4. TARGET ORGANS/CRITICAL EFFECTS**

No data were available to determine target organs/critical effects for oral, inhalation, or other routes of exposure to benzo[b]fluoranthene.

## **4. CARCINOGENICITY**

### **4.1. ORAL EXPOSURES**

Information on the carcinogenicity of benzo[b]fluoranthene in humans or animals following oral exposure was not available.

### **4.2. INHALATION EXPOSURES**

#### **4.2.1. Human**

Although there are no human data that specifically link exposure to benzo[b]fluoranthene to human cancers, benzo[b]fluoranthene is a component of mixtures that have been associated with human cancer. These mixtures include coal tar, soots, coke oven emissions, and cigarette smoke (U.S. EPA, 1994).

#### **4.2.2. Animal**

Information on the carcinogenicity of benzo[b]fluoranthene in animals following inhalation exposure was not available.

### 4.3. OTHER ROUTES OF EXPOSURE

#### 4.3.1. Human

Information on the carcinogenicity of benzo[*b*]fluoranthene in humans by other routes of exposure was not available.

#### 4.3.2. Animal

Benzo[*b*]fluoranthene was tested for carcinogenicity in dermal application, lung implantation, subcutaneous (s.c.) injection, and intraperitoneal (i.p.) injection bioassays.

Wynder and Hoffmann (1959) applied 0.01, 0.1, or 0.5% solutions of benzo[*b*]fluoranthene in acetone three times weekly to the skin of three groups of 20 Swiss mice for life. There were no untreated or vehicle controls. The highest dose produced skin papillomas in 100% and carcinomas in 90% of treated mice within 8 months; the intermediate dose produced papillomas in 65% and carcinomas in 85% of treated mice within 12 months. Of 10 surviving mice that received the lowest dose, only one animal developed a papilloma after 14 months.

A single dermal application of 1 mg benzo[*b*]fluoranthene in acetone produced no tumors in 20 Swiss mice during a 63-week observation period (Van Duuren et al., 1966). However, the same protocol followed by repeated applications of croton resin produced papillomas in 18/20 and carcinomas in 5/20 treated mice.

LaVoie et al. (1982) evaluated the tumor-initiating activity of benzo[*b*]fluoranthene by applying initiation doses of 0, 10, 30, or 100  $\mu$ g benzo[*b*]fluoranthene in acetone (10 doses, every other day) to the skin of Crl:CD-1 mice (20/group). This procedure was followed by treatment with 12-*o*-tetradecanoyl-phorbol-13-acetate (TPA), 3 times weekly for 20 weeks. There was a dose-related increased incidence of skin tumors, predominantly squamous cell papillomas. Skin tumors were seen in 0, 45, 60, and 80% of mice treated with 0, 10, 30, or 100  $\mu$ g benzo[*b*]fluoranthene, respectively. A similar initiation/protocol by Amin et al. (1985) resulted in a comparable increased incidence of skin tumors in female Swiss albino mice.

Sixteen male and 14 female XVII nc/Z mice were given three s.c. injections of 0.6 mg benzo[*b*]fluoranthene in olive oil over a period of 2 months (Lacassagne et al., 1963). Injection site sarcomas developed in 18/24 surviving mice, with an average latent period of 4.5 months.

Female Osborne-Mendel rats (35/group) received single lung implants of 0.1, 0.3, or 1 mg benzo[*b*]fluoranthene in a mixture of beeswax and trioctanoin (Deutsch-Wenzel et al., 1983). An untreated group and a group receiving the vehicle served as controls. Granulomatous inflammatory lesions developed at the injection sites. After a lifetime of observation, there was a dose-related increased incidence of epidermoid carcinomas and pleomorphic sarcomas in the lung and thorax (combined). The observed incidences were 1/35, 3/35, and 13/35, respectively, in the low-, mid-, and high-dose groups. No lung tumors were reported in untreated and vehicle controls. In contrast, multiple intratracheal instillations of benzo[*b*]fluoranthene, administered as 30 weekly doses of 0.05 or 0.5 mg, did not induce a significant number of respiratory tract tumors in male Syrian golden hamsters (Sellakumar and Shubik, 1974). The group receiving the higher dose had one papilloma of the trachea at week 99.

LaVoie et al. (1987) administered i.p. injections of benzo[*b*]fluoranthene in dimethyl sulfoxide to newborn CD-1 mice (15 males and 17 females) on days 1, 8, and 15 of age at a total dose of 0.5  $\mu$ mol/mouse. The animals were sacrificed at 52 weeks of age. Treatment with benzo[*b*]fluoranthene induced hepatic tumors (adenomas and hepatomas combined) in eight male mice. One hepatoma developed in 1/17 male controls; no hepatic tumors were seen in female treated mice or in female controls. Lung adenomas were found in two male and in three female mice; no lung tumors occurred in controls.

#### 4.4. EPA WEIGHT-OF-EVIDENCE

Classification -- B2; probable human carcinogen (U.S. EPA, 1994)

Basis -- Based on no human data and sufficient data from animal bioassays.

Benzo[b]fluoranthene produced tumors in mice after lung implantation, i.p. or s.c. injection, or skin painting.

#### 4.5. CARCINOGENICITY SLOPE FACTORS

None were calculated.

### 5. REFERENCES

Amin, S., E.J. LaVoie and S.S. Hecht. 1982. Identification of metabolites of benzo[b]fluoranthene. *Carcinogenesis* 3: 171-174.

Amin, S., K. Huie and S.S. Hecht. 1985. Mutagenicity and tumor initiating activity of methylated benzo[b]fluoranthene. *Carcinogenesis* 6: 1023-1025.

ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,i,h)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-c,d)pyrene, Phenanthrene, Pyrene. Prepared by Clement International Corporation, under Contract No. 205-88-0608. ATSDR/TP-90-20.

Deutsch-Wenzel, R.P., H. Brune, G. Grimmer, et al. 1983. Experimental studies in rat lungs on the carcinogenicity and dose-response relationships of eight frequently occurring environmental polycyclic aromatic hydrocarbons. *J. Natl. Cancer Inst.* 71: 539-544.

Geddie, J.E., S. Amin, K. Hui, et al. 1987. Formation and tumorigenicity of benzo[b]fluoranthene metabolites in mouse epidermis. *Carcinogenesis* 8: 1579-1584.

IARC (International Agency for Research on Cancer). 1973. Benzo[b]fluoranthene. In: *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man. Certain Polycyclic Aromatic Hydrocarbons and Heterocyclic Compounds*, Vol 3. IARC, Lyon, France, pp. 69-81.

IARC (International Agency for Research on Cancer). 1983. Benzo[b]fluoranthene. In: *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans. Polycyclic Aromatic Compounds, Part 1, Chemical, Environmental and Experimental Data*, Vol 32. IARC, Lyon, France, pp. 33-91, 147-153.

Lacassagne, A., N.P. Buu-Hoi, F. Zajdela, et al. 1963. Activite cancerogene d'hydrocarbures aromatiques polycycliques a noyau fluoranthene. *Un. Int. Cancer Acta* 19: 490-496. (French; cited in IARC, 1973)

LaVoie, E.J., S. Amin, S.S. Hecht, et al. 1982. Tumor initiating activity of dihydrodiols of benzo[b]fluoranthene, benzo[j]fluoranthene, and benzo[k]fluoranthene. *Carcinogenesis* 3: 49-52.

LaVoie, E.J., J. Braley, J.E. Rice, et al. 1987. Tumorigenic activity for non-alternant polynuclear aromatic hydrocarbons in newborn mice. *Cancer Lett.* 34: 15-20.

Lide, D.R., Ed. 1991. *CRC Handbook of Chemistry and Physics*, 1991-1992, 72nd ed. Boca Raton, FL, p. 3-96.

Sellakumar, A. and P. Shubik. 1974. Carcinogenicity of different polycyclic hydrocarbons in the respiratory tract of hamsters. J. Natl. Cancer Inst. 53: 1713-1719.

U.S. EPA (U.S. Environmental Protection Agency). 1991. Drinking Water Criteria Document for Polycyclic Aromatic Hydrocarbons (PAH). Prepared by the Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, U.S. Environmental Protection Agency, Cincinnati, OH, for the Office of Drinking Water. ECAO-CIN-D010.

U.S. EPA (U.S. Environmental Protection Agency). 1994. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH.

Van Duuren, B.L., A. Sivak, A. Segal, et al. 1966. The tumor-promoting agents of tobacco leaf and tobacco smoke condensate. J. Natl. Cancer Inst. 37: 519 -526.

Wynder, E.L. and D. Hoffmann. 1959. The carcinogenicity of benzo(a)fluoranthenes. Cancer 12: 1194-1199.

TOXICITY SUMMARY FOR  
BENZO[k]FLUORANTHENE

May 1994

Prepared by:

Rosmarie A. Faust, Ph.D.  
Chemical Hazard Evaluation Group  
Biomedical and Environmental Information Analysis Section  
Health Sciences Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for:

U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Environmental Branch, Technology Division  
U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

---

\*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under  
Contract No. DE-AC05-84OR21400



## EXECUTIVE SUMMARY

Benzo[k]fluoranthene, a crystalline solid with a chemical formula of  $C_{20}H_{12}$  and a molecular weight of 252.32 (Lide, 1991), is a polycyclic aromatic hydrocarbon (PAH) with one five-membered and four six-membered rings. There is no commercial production or known use of this compound (IARC, 1983). Benzo[k]fluoranthene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion (IARC, 1983) and in soils, groundwater, and surface waters at hazardous waste sites (ATSDR, 1990).

No absorption or excretion data were available for benzo[k]fluoranthene; however, by analogy to structurally-related PAHs, primarily benzo[a]pyrene, it would be expected to be absorbed from the gastrointestinal tract, lungs, and skin (U.S. EPA, 1991). Rat liver microsomes have been shown to metabolize benzo[k]fluoranthene to the dihydrodiol, 8,9-dihydro-8,9-dihydroxy benzo[k]fluoranthene (LaVoie et al., 1980).

No data were found concerning the acute, subchronic, chronic, developmental, or reproductive toxicity of benzo[k]fluoranthene. Because of a lack of toxicity data, an oral reference dose (RfD) or inhalation reference concentration (RfC) have not been derived (U.S. EPA, 1994).

No long-term oral or inhalation bioassays were available to assess the carcinogenicity of benzo[k]fluoranthene. Benzo[k]fluoranthene was tested for carcinogenicity in dermal application, subcutaneous (s.c.) injection, lung implantation, and intraperitoneal (i.p.) injection studies. Dermal applications of 0.5% solutions of benzo[k]fluoranthene for life produced only a few skin papillomas in mice (Wynder and Hoffmann, 1959), but in initiation-promotion assays, benzo[k]fluoranthene was active as an initiator of skin carcinogenesis (LaVoie et al., 1982; Amin et al., 1985). Injection site sarcomas developed in mice given three s.c. injections of 0.6 mg benzo[k]fluoranthene (Lacassagne et al., 1963) and dose-related increases of epidermoid carcinomas of the lungs were reported in rats receiving single lung implants of 0.16-4.15 mg benzo[k]fluoranthene (Deutsch-Wenzel et al., 1983). In a short-term assay, hepatic and lung tumors occurred in newborn mice receiving 2.1  $\mu$ mol benzo[k]fluoranthene via i.p. injection (LaVoie et al., 1987).

Based on no human data and sufficient evidence for carcinogenicity in animals, EPA has assigned a weight-of-evidence classification of B2, probable human carcinogen, to benzo[k]fluoranthene (U.S. EPA, 1994).

## 1. INTRODUCTION

Benzo[k]fluoranthene (CAS Reg. No. 207-08-9), also known as 8,9-benzofluoranthene; 11,12-benzofluoranthene; 2,3,1',8'-binaphthylene; and dibenzo(b,j,k)fluorene (IARC, 1983) is a polycyclic aromatic hydrocarbon (PAH) with one five-membered and four six-membered rings. It is a crystalline solid with a chemical formula of  $C_{20}H_{12}$ , a molecular weight of 252.32, a melting point of 217°C (Lide, 1991), and a boiling point of 480°C (IARC, 1983). Benzo[k]fluoranthene is insoluble in water, but is soluble in acetic acid, benzene, and ethanol (IARC, 1983). It has a vapor pressure of  $9.59 \times 10^{-11}$  mm Hg at 25°C, an estimated octanol/water partition coefficient of 6.04-6.44 (U.S. EPA, 1987), and a Henry's Law constant of  $3.87 \times 10^{-5}$  (ATSDR, 1990).

There is no commercial production or commercial use of benzo[k]fluoranthene; small amounts of this compound are used for research (IARC, 1983). Benzo[k]fluoranthene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion. It has been detected in mainstream cigarette smoke; gasoline engine exhaust; emissions from burning of coal and from oil-fired heating; lubricating oils; used motor oils; crude oils (IARC, 1983); and in soils, surface waters, and groundwater at hazardous waste sites (ATSDR, 1990). Benzo[k]fluoranthene is one of a number of PAHs on EPA's priority pollutant list (ATSDR, 1990).

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

Data regarding the gastrointestinal or pulmonary absorption of benzo[k]fluoranthene in humans or animals were not available. However, data from structurally-related PAHs, primarily benzo[a]pyrene, suggest that benzo[k]fluoranthene would be absorbed from the gastrointestinal tract, lungs, and skin (U.S. EPA, 1991).

### 2.2. DISTRIBUTION

No human or animal data were available concerning the tissue distribution of benzo[k]fluoranthene.

### 2.3. METABOLISM

No data were available concerning the *in vivo* metabolism of benzo[k]fluoranthene. In *in vitro* metabolism studies using rat liver microsomes, LaVoie et al. (1980) identified 8,9-dihydro-8,9-dihydroxy benzo[k]fluoranthene as the major metabolite of benzo[k]fluoranthene.

### 2.4. EXCRETION

No human or animal data were available concerning the excretion of benzo[k]fluoranthene.

### **3. NONCARCINOGENIC HEALTH EFFECTS**

#### **3.1. ORAL EXPOSURES**

Information on the acute, subchronic, chronic, developmental, or reproductive oral toxicity of benzo[k]fluoranthene in humans or animals was not available. Because of a lack of toxicity data, an oral reference dose (RfD) for benzo[k]fluoranthene has not been derived (U.S. EPA, 1994).

#### **3.2. INHALATION EXPOSURES**

Information on the acute, subchronic, chronic, developmental, or reproductive oral toxicity of benzo[k]fluoranthene in humans or animals following inhalation exposure was not available. Because of a lack of toxicity data, an inhalation reference concentration (RfC) for benzo[k]fluoranthene has not been derived (U.S. EPA, 1994).

#### **3.3. OTHER ROUTES OF EXPOSURE**

Information on the acute, subchronic, chronic, developmental, or reproductive oral toxicity of benzo[k]fluoranthene in humans or animals by other routes of exposure was not available.

#### **3.4. TARGET ORGANS/CRITICAL EFFECTS**

No data were available to identify target organs/critical effects for oral, inhalation, or other routes of exposure to benzo[k]fluoranthene.

### **4. CARCINOGENICITY**

#### **4.1. ORAL EXPOSURES**

Information on the carcinogenicity of benzo[k]fluoranthene in humans or animals following oral exposure was not available.

#### **4.2. INHALATION EXPOSURES**

##### **4.2.1. Human**

Although there are no human data that specifically link exposure to benzo[k]fluoranthene to human cancers, benzo[b]fluoranthene is a component of mixtures that have been associated with human cancer. These mixtures include coal tar, soots, coke oven emissions, and cigarette smoke (U.S. EPA, 1994).

#### 4.2.2. Animal

Information on the carcinogenicity of benzo[k]fluoranthene in animals following inhalation exposure was not available.

### 4.3. OTHER ROUTES OF EXPOSURE

#### 4.3.1. Human

Information on the carcinogenicity of benzo[k]fluoranthene in humans by other routes of exposure was not available.

#### 4.3.2. Animal

Benzo[k]fluoranthene was tested for carcinogenicity in skin application, initiation-promotion, lung implant, subcutaneous (s.c.) injection, and intraperitoneal (i.p.) injection bioassays.

Wynder and Hoffmann (1959) applied 0.1 or 0.5% solutions of benzo[k]fluoranthene in acetone three times weekly to the skin of three groups of 20 female Swiss mice. No untreated or vehicle controls were used. At the end of the 13th month, all surviving mice (8/20 and 3/20 treated with the low and high dose, respectively) were killed. Skin papillomas developed in two mice receiving the high dose; no skin tumors were seen in the low dose group. Habs et al. (1980) found no significant increase in tumor incidence when groups of 40 female NMRI mice were given dermal applications of 3.4, 5.6, or 9.2  $\mu\text{g}$  benzo[k]fluoranthene two times weekly for life. Only one tumor was found in a mouse receiving the highest dose.

LaVoie et al. (1982) evaluated the tumor-initiating activity of benzo[k]fluoranthene by applying initiation doses of 0, 3, 10, or 100  $\mu\text{g}$  benzo[k]fluoranthene in acetone (10 doses, every other day) to the skin of groups of 20 Crl:CD-1 mice. This procedure was followed by treatment with 12-*o*-tetradecanoylphorbol-13-acetate (TPA), 3 times weekly for 20 weeks. There was a dose-related increased incidence of skin tumors, predominantly squamous cell papillomas. Skin tumors were seen in 0, 5, 25, and 75% of mice treated with 0, 10, 30, or 100  $\mu\text{g}$  benzo[k]fluoranthene, respectively. Using a similar initiation/promotion protocol, Amin et al. (1985) applied 101  $\mu\text{g}$  benzo[k]fluoranthene in acetone every 2 days for 20 days to the skin of 20 female Crl:CD-1 mice, followed 10 days later by TPA treatment 3 times weekly for 20 weeks. Skin tumors were reported in 0 and 37% of vehicle control and treated mice, respectively.

Female Osborne-Mendel rats (27-35/group) received single lung implants of 0.16, 0.83, or 4.15 mg benzo[k]fluoranthene in a mixture of beeswax and trioctanoin (Deutsch-Wenzel et al., 1983). An untreated group and a group receiving the vehicle served as controls. Granulomatous inflammatory lesions developed at the injection sites. After a lifetime of observation, there was a dose-related increase of epidermoid carcinomas of the lung. The observed incidences were: untreated controls, 1/35; vehicle controls, 0/35; low dose group, 0/35; mid dose group, 3/31; and high dose group, 12/27.

Sixteen male and 14 female XVII nc/Z mice were given s.c. injections of 0.6 mg benzo[k]fluoranthene in olive oil once a month for 3 months (Lacassagne et al., 1963). Injection site sarcomas developed in both male and female mice, respectively. The average latency period for sarcomas was 203 days (males) and 210 days (females).

LaVoie et al. (1987) administered i.p. injections of benzo[k]fluoranthene in dimethyl sulfoxide to 16 male and 18 female CD-1 mice on days 1, 8, and 15 of life at a total dose of 2.1  $\mu$ mol/mouse. The animals were sacrificed at 52 weeks of age. Hepatic tumors (adenomas and hepatomas combined) were seen in 3/16 of treated male mice; one hepatoma was seen in 1/17 of male controls. No hepatic tumors developed in female treated mice or in female controls. Lung adenomas were found in 1/16 and 3/18 treated male and female mice, respectively; no lung tumors occurred in controls.

#### **4.4. EPA WEIGHT-OF-EVIDENCE**

Classification -- B2; probable human carcinogen (U.S. EPA, 1994)

Basis -- Based on no human data and sufficient data from animal bioassays.

Benzo[k]fluoranthene produced tumors in mice after lung implantation and when administered by dermal application with a promoting agent. Equivocal results were obtained in a lung adenoma assay with mice. Benzo[k]fluoranthene was mutagenic in bacteria.

#### **4.5. CARCINOGENICITY SLOPE FACTORS**

None were calculated.

## 5. REFERENCES

- Amin, S., N. Hussain, G. Balanikas, et al. 1985. Mutagenicity and tumor initiating activity of methylated benzo[k]fluoranthenes. *Cancer Lett.* 26: 343-347.
- ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,i,h)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-c,d)pyrene, Phenanthrene, Pyrene. Prepared by Clement International Corporation, under Contract No. 205-88-0608. ATSDR/TP-90-20.
- Deutsch-Wenzel, R.P., H. Brune, G. Grimmer, et al. 1983. Experimental studies in rat lungs on the carcinogenicity and dose-response relationships of eight frequently occurring environmental polycyclic aromatic hydrocarbons. *J. Natl. Cancer Inst.* 71: 539-544.
- Habs, M., D. Schmahl and J. Misfield. 1980. Local carcinogenicity of some environmentally relevant polycyclic aromatic hydrocarbons after lifelong topical application to mouse skin. *Arch. Geschwulstforsch.* 50: 266-274. (Cited in U.S. EPA, 1991)
- IARC (International Agency for Research on Cancer). 1983. Benzo[k]fluoranthene. In: IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans. Polycyclic Aromatic Compounds, Part 1, Chemical, Environmental and Experimental Data, Vol 32. IARC, Lyon, France, pp. 163-170.
- Lacassagne, A., N.P. Buu-Hoi, F. Zajdela, et al. 1963. Activite cancerogene d'hydrocarbures aromatiques polycycliques a noyau fluoranthene. *Un. Int. Cancer Acta* 19: 490-496. (French; cited in IARC, 1973)
- LaVoie, E.J., S.S. Hecht, S.S. Amin, et al. 1980. Identification of mutagenic dihydrodiols as metabolites of benzo[j]fluoranthene and benzo[k]fluoranthene. *Cancer Res.* 40: 4528-4532.
- LaVoie, E.J., S. Amin, S.S. Hecht, et al. 1982. Tumor-initiating activity for dihydrodiols of benzo[b]fluoranthene, benzo[j]fluoranthene and benzo[k]fluoranthene. *Carcinogenesis* 3: 49-52.
- LaVoie, E.J., J. Braley, J.E. Rice and A. Rivenson. 1987. Tumorigenic activity for non-alternant polynuclear aromatic hydrocarbons in newborn mice. *Cancer Lett.* 34: 15-20.
- Lide, D.R., Ed. 1991. CRC Handbook of Chemistry and Physics, 1991-1992, 72nd ed. Boca Raton, FL, p. 3-96.
- U.S. EPA (U.S. Environmental Protection Agency). 1987. Health and Environmental Effects Profile for Benzo[k]fluoranthene. Prepared by the Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH, for the Office of Solid Waste and Emergency Response. ECAO-CIN-P229.

U.S. EPA (U.S. Environmental Protection Agency). 1991. Drinking Water Criteria Document for Polycyclic Aromatic Hydrocarbons (PAH). Prepared by the Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, U.S. Environmental Protection Agency, Cincinnati, OH, for the Office of Drinking Water. ECAO-CIN-D010.

U.S. EPA (U.S. Environmental Protection Agency). 1994. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH.

Wynder, E.L. and D. Hoffmann. 1959. The carcinogenicity of benzo(a)fluoranthenes. Cancer 12: 1194-1199. (Cited in IARC, 1983)

**TOXICITY SUMMARY FOR  
*Bis*(2-ETHYLHEXYL)PHTHALATE**

March 1993

Prepared By

Andrew Francis, M.S., DABT  
Chemical Hazard Evaluation Group  
Biomedical Environmental Information Analysis Section  
Health and Safety Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for

U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Environmental Branch, Technology Division  
U.S. ARMY ENVIRONMENTAL  
Aberdeen Proving Ground, Maryland 210-5401

---

\*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400



## EXECUTIVE SUMMARY

*Bis*(2-ethylhexyl)phthalate is a colorless oily liquid that is extensively used as a plasticizer in a wide variety of industrial, domestic and medical products. It is an environmental contaminant and has been detected in ground water, surface water, drinking water, air, soil, plants, fish and animals (Sittig, 1985; Sandmeyer and Kirwin, 1978). It is rapidly absorbed from the gastrointestinal tract primarily as mono(2-ethylhexyl)phthalate (Pollack et al., 1985; Teirlynck and Belpaire, 1985). The diester can be absorbed through the skin and from the lungs (Elsisi et al., 1989; Pegg, 1982). It is rapidly metabolized in the blood and tissues to the monoester, which can be excreted as a glucuronide conjugate or further hydrolyzed to phthalic acid and excreted (Kluwe, 1982; Albro et al., 1982).

Animal studies have indicated that the primary target organs are the liver and kidneys (Carpenter et al., 1953; U.S. EPA, 1987a,b); however, higher doses are reported to result in testicular effects and decreased hemoglobin and packed cell volume (Kluwe et al., 1982; Gray et al., 1977). The primary intracellular effects of *bis*(2-ethylhexyl)phthalate in the liver and kidneys are an increase in the smooth endoplasmic reticulum and a proliferation in the number and size of peroxisomes (Kluwe et al., 1982; Reddy and Lalwani, 1983; Tomaszewski et al., 1986). An epidemiological study reported no toxic effects from occupational exposure to air concentrations of *bis*(2-ethylhexyl)phthalate up to 0.16 mg/m<sup>3</sup> (Thiess et al., 1978). Other studies on occupational exposures to mixtures of phthalate esters containing *bis*(2-ethylhexyl)phthalate have reported polyneuritis and sensory-motor polyneuropathy with decreased thrombocytes, leukocytes and hemoglobin in some exposed workers (Milkov et al., 1973; Gilioli et al., 1978). Developmental toxicity studies with rats and mice have shown that *bis*(2-ethylhexyl)phthalate is fetotoxic and teratogenic when given orally during gestation (Wolkowski-Tyl et al., 1984a and b; Shiota and Mima, 1985). Oral exposure has also been shown to result in decreased sperm count in rats (Siddipui and Srivastava, 1992).

A Reference Dose (RfD) of 0.02 mg/kg/day for both subchronic and chronic oral exposure was calculated from a lowest-observed-adverse-effect level (LOAEL) of 19 mg/kg/day based on increased relative liver weight in guinea pigs given 0, 19, or 64 mg *bis*(2-ethylhexyl) phthalate/kg/day for 12 months in their diet (Carpenter et al., 1953; U.S. EPA, 1992 a,b). A Reference Concentration (RfC) for inhalation exposure is not available (U.S. EPA, 1992b).

*bis*(2-ethylhexyl)phthalate is known to induce the proliferation of peroxisomes, which has been associated with carcinogenesis (Rao and Reddy, 1991). Dose-dependent, statistically-significant increases in the incidences of hepatocellular carcinomas and combined carcinomas and adenomas were seen in mice and rats exposed to *bis*(2-ethylhexyl)phthalate in their diet for 103 weeks (Kluwe, et al., 1982). An increased incidence of neoplastic nodules and hepatocellular carcinomas was also reported in rats (Rao et al., 1990).

Based on U.S. EPA guidelines, *bis*(2-ethylhexyl)phthalate was assigned to weight-of-evidence Group B2, probable human carcinogen, on the basis of an increased incidence of liver tumors in rats and mice. A carcinogenicity slope factor ( $q_1^*$ ) of 0.014 (mg/kg/day)<sup>-1</sup> for oral exposure was based on the combined incidence of hepatocellular carcinomas and adenomas in male mice (Kluwe, et al., 1982; U.S. EPA, 1992b). A drinking water unit risk of 4.0E-7 (μg/L)<sup>-1</sup> was calculated based on the  $q_1^*$ . A quantitative estimation of carcinogenic risk from inhalation exposure is not available (U.S. EPA, 1992b).

## 1. INTRODUCTION

*Bis*(2-ethylhexyl)phthalate or di(2-ethylhexyl)phthalate ( $C_{24}H_{38}O_4$ , CAS registry number 117-81-3) is a clear oily liquid with a molecular weight of 390.54. It has a melting point of  $-50^{\circ}\text{C}$ ; a boiling point of  $387^{\circ}\text{C}$  at 760 mm Hg and  $230^{\circ}\text{C}$  at 5 mm Hg; and a vapor pressure of 1.2 mm Hg at  $200^{\circ}\text{C}$ . It has a density of 0.9861 and is practically insoluble in water (0.40 mg/L at  $25^{\circ}\text{C}$ ). *bis*(2-ethylhexyl)phthalate has a flash point of  $218.3^{\circ}\text{C}$ . The relatively high flash point, boiling point and low vapor pressure contribute to the high stability of this phthalic acid ester (Sittig, 1985; Sandmeyer and Kirwin, 1978; U.S. EPA, 1987a).

*Bis*(2-ethylhexyl)phthalate is primarily used in the plastics industry as a plasticizer with such varied applications as wire insulation, food packaging and biomedical applications such as tubing and blood containers. Other uses include vacuum pump oil and as a dielectric fluid in capacitors (U.S. EPA, 1987b; Budavari, 1989). The combined annual production of dioctyl phthalates in the United States exceeds 300 million pounds (U.S. EPA, 1987b). The wide-spread uses of *bis*(2-ethylhexyl)phthalate have made the compound, along with other phthalic acid esters, ubiquitous in the environment. It has been detected in ground water, surface water, drinking water, air, soil, plants, fish and animals. Air concentrations in certain PVC manufacturing plants have been reported to range from below 0.02 to 0.5 mg/m<sup>3</sup> (Vainiotalo and Pfaffli, 1990). Some exposure occurs from leaching of the compound from containers used in the food and medical industries (U.S. EPA, 1987b; Callahan et al., 1979). This is of particular concern to patients exposed to large amounts of blood or blood products. The chemical is extracted from the containers by the blood and is converted to mono(2-ethylhexyl)phthalate by a plasma enzyme (Labow et al., 1988). Experiments have shown that 3.3 mg *bis*(2-ethylhexyl)phthalate/gm of bag material were extracted in five days with bovine calf serum, whereas bags tested with saline resulted in no soluble plasticizers (Chawla and Hinberg, 1991).

In the environment, *bis*(2-ethylhexyl)phthalate undergoes biodegradation in water and soil, and is predicted to react with hydroxyl radicals in the atmosphere. It is estimated to have a half life of about 12 hours in the air, 10 to 20 days in the soil, and days to weeks in water (U.S. EPA, 1987a,b). Volatilization of *bis*(2-ethylhexyl)phthalate from contaminated water does not contribute significantly to its removal. The half-life of the molecule due to evaporation alone from bodies of water has been estimated to be as long as 15 years (U.S. EPA, 1987a,b; Callahan et al., 1979). In the marine environment *bis*(2-ethylhexyl)phthalate has been shown to be rapidly degraded by experimental microcosms (Davey et al., 1990). It has been found to bind to organic acids in the soil and water resulting in an increase in its solubility and its mobility in the environment (Matsuda and Schnitzer, 1971). It also adsorbs to both freshwater and marine sediments where it may serve as a long-term sink (U.S. EPA, 1987; Sullivan et al., 1982).

Experiments have shown that fish do not extensively bioaccumulate *bis*(2-ethylhexyl)phthalate. Rainbow trout studies indicate that the diester is converted to the monoester by the gills before absorption from the water occurs, thus limiting the absorption of the diester (Barron et al., 1989).

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

*Bis*(2-ethylhexyl)phthalate can be absorbed from the gastrointestinal tract, the lungs, and through the skin. Over 90% of an oral dose of *bis*(2-ethylhexyl)phthalate was absorbed by the gastrointestinal tract of rats as evidenced by the excretion of metabolites (Williams and Blanchfield, 1974). However, gastrointestinal absorption is complicated by the hydrolysis of the diester to the monoester derivative by pancreatic enzymes and enzymes in intestinal mucosal cells. The monoester is then absorbed. Gavage studies on rats by Teirlynck and Belpaire (1985) showed an average plasma concentration of 8.8  $\mu\text{g/ml}$  of the diester compared to 63.2  $\mu\text{g/ml}$  of the monoester 3 hours following a single oral dose of 2.8 g/kg of *bis*(2-ethylhexyl)phthalate. Similar studies by

Pollack et al. (1985) demonstrated that 80% of a single oral dose was absorbed as the monoester, whereas only 13% of the dose was absorbed as *bis*(2-ethylhexyl)phthalate. These observations must be taken into account when route-to-route extrapolations are considered (U.S. EPA, 1987b).

Although it is known that phthalic acid esters can be absorbed by inhalation, there are little quantitative data available for this route of exposure (U.S. EPA 1987a). Pegg (1982) studied the pulmonary absorption of an aerosol of  $^{14}\text{C}$ -*bis*(2-ethylhexyl)phthalate by adult male Sprague-Dawley rats. The animals were exposed for 6 hours to a concentration of 100 mg/m<sup>3</sup> in a heads-only chamber. The radioactivity appearing in the blood at various times following exposure and the radioactivity recovered from urine, feces, skin and the carcass were measured 72 hours after exposure. The disappearance of radioactivity from lung tissue was also measured leading to the conclusion that absorption was rapid and complete.

*Bis*(2-ethylhexyl)phthalate can also be absorbed through the skin. This is primarily a hazard for workers in the plastics industry, but other exposures can occur such as contact with the chemical leached from vinyl swimming pool liners (U. S. EPA 1980). Quantitative absorption data are not available, however, guinea pig studies have indicated a LD<sub>50</sub> of 10 g/kg for dermal exposure (Autian, 1973; U.S. EPA, 1980). Excretion and distribution of radioactive labeled [ $^{14}\text{C}$ ]-*bis*(2-ethylhexyl)phthalate applied to the shaved backs of male F-344 rats at concentrations of 30 to 40 mg/kg was followed over a period of seven days demonstrating dermal absorption by rats (see sections 2.2 and 2.4) (Elsisi et al., 1989).

## 2.2. DISTRIBUTION

*Bis*(2-ethylhexyl)phthalate and its metabolites are distributed primarily to plasma, liver, kidney, the gastrointestinal tract, and fat following oral exposure. Some metabolites have been found in almost all tissues especially the monoester metabolite, which has been found in relatively high concentration in the testes of rats. Maximum concentrations of *bis*(2-ethylhexyl)phthalate and the monoester metabolite were reached in blood and the tissues in 6-24 hours after a single oral dose of 9.8 g/kg in corn oil (Oishi and Hiraga, 1982; U.S. EPA, 1987b). Elsisi et al. (1989) applied 30 to 40 mg *bis*(2-ethylhexyl)phthalate/kg to the shaved backs of F-344 rats and followed the distribution of radioactive label. Most of the label was found in fat, skin and muscle after seven days.

## 2.3. METABOLISM

The first step in metabolism of *bis*(2-ethylhexyl)phthalate is hydrolysis to the monoester derivative, which primarily occurs in the gastrointestinal tract following oral exposure, but also occurs in the tissues. A glucuronide conjugate can be formed with the monoester or the terminal or next to last carbon in the monoester molecule can be oxidized. After the carboxylic acid derivative is formed, the length of the side chain can be decreased by  $\beta$  oxidation. The monoester can also be hydrolyzed to phthalic acid (Klue, 1982; Albro et al., 1982; Williams and Blanchfield 1974; U.S. EPA, 1987b).

Rat studies indicate that the diester is removed faster from most tissues than the monoester with half-lives from 1.5 hours for lung tissue to 28.4 hours for liver and 156 hours for epididymal fat. *bis*(2-ethylhexyl)phthalate is fat soluble and remains unmetabolized in fat tissue much longer than in other tissues. The monoester has a half-life of about 32 hours in liver tissue and 68 hours in epididymal fat. It also has a half-life of about 50 hours in the testes, compared to 8.3 hours for the diester (Oishi and Hiraga, 1982; U.S. EPA 1987b).

The mono(2-ethylhexyl)phthalate metabolite has been shown to accumulate in the testes of rats following treatment with *bis*(2-ethylhexyl)phthalate (Oishi, 1990). In vitro studies have shown that testicular tissue does not further metabolize the monoester (Albro et al., 1989).

## 2.4. EXCRETION

Since *bis*(2-ethylhexyl)phthalate is rapidly converted to the monoester derivative, solubilization and excretion of the monoester becomes the primary metabolic task. Most species tested, including humans, excrete the monoester as a glucuronide conjugate in the urine, feces and bile. Rats, apparently, are an exception and primarily oxidize the terminal or next to last carbon in the monoester molecule before excretion. The monoester can also be further hydrolyzed to phthalic acid and excreted (Kluwe, 1982; Albro et al., 1982). An average half-life of about 12 hours has been reported in humans following a single dose of *bis*(2-ethylhexyl)phthalate (Schmid and Schlaffer, 1985; U.S. EPA, 1987b). Excretion of [<sup>14</sup>C]-*bis*(2-ethylhexyl)phthalate after dermal absorption in F-344 rats was followed over a period of seven days. Radioactive label was found in the urine and feces; urine was the major route of elimination (Elsisi et al., 1989).

## 3. NONCARCINOGENIC HEALTH EFFECTS

### 3.1. ORAL EXPOSURES

#### 3.1.1. Acute Toxicity

##### 3.1.1.1. Human

Ingestion of 5 and 10 g of *bis*(2-ethylhexyl)phthalate by human volunteers resulted in mild gastrointestinal disturbances with the 10 g dose and no effects from the 5 g dose (Shaffer et al., 1945).

##### 3.1.1.2. Animal

Oral LD<sub>50</sub> values of 30 g/kg, 30.6 g/kg, and 34 g/kg have been listed for mice, rats and rabbits respectively (Sittig, 1985; Sax and Lewis, 1989).

#### 3.1.2. Subchronic Toxicity

##### 3.1.2.1. Human

Information on the subchronic oral toxicity of *bis*(2-ethylhexyl)phthalate in humans was not available.

##### 3.1.2.2. Animal

Gray et al. (1977) observed a variety of symptoms after feeding groups of 15 male and 15 female Sprague Dawley rats 0, 0.2, 1.0, or 2% *bis*(2-ethylhexyl)phthalate (0, 150, 750, or 1500 mg/kg/day, respectively) in their diet for 17 weeks. Increased absolute and relative liver weights were observed in all treated groups. Food consumption and growth rates were reduced in the 1 and 2% treated groups. A dose-related reduction in testicular weight and an increase in testicular damage were observed. Decreased hemoglobin concentration was observed in male rats, and decreased packed red cell volume was also observed in both sexes in the two highest dose groups. An interstitial nephritis, increased SGPT and decreased blood glucose were reported by Nagasaki et al. (1974) in a 48 week rat study (U.S.EPA, 1987a). Animals in this study were fed 500 or 1000 ppm *bis*(2-ethylhexyl)phthalate in the diet (25 or 50 mg/kg/day, respectively). Ota et al. (1974) reported degenerative changes in the kidneys and liver of mice given 0.5 to 5 g/kg/day in the diet for 1 to 3 months. Male albino ferrets fed 1% *bis*(2-ethylhexyl)phthalate in the diet for 14 months exhibited decreased body weight, increased liver weight with morphological and biochemical changes, and testicular damage (Lake et al., 1976; U.S. EPA 1987b).

### 3.1.3. Chronic Toxicity

#### 3.1.3.1. Human

Information on the chronic oral toxicity of *bis*(2-ethylhexyl)phthalate in humans was not available.

#### 3.1.3.2. Animal

Carpenter et al. (1953) fed groups of 32 male and 32 female Sherman rats 0, 0.04, 0.13, or 0.4% *bis*(2-ethylhexyl)phthalate (0, 20, 60, or 200 mg/kg/day, respectively) in the diet for one year during which time they were allowed to breed. After one year, groups of eight males and eight females were continued on the same regimen and groups of 32 male and 32 female offspring were fed 0, and 0.4% (200 mg/kg/day) *bis*(2-ethylhexyl)phthalate in the diet. Significantly increased liver and kidney weights were observed with the high dose in the male parental group and in both sexes of the F<sub>1</sub> groups. No other treatment related effects were reported in the rats. The same study also included guinea pigs and dogs. Groups of 22-24 male and 22-24 female guinea pigs were fed the equivalent of 0, 19 or 64 mg/kg/day *bis*(2-ethylhexyl)phthalate for one year. Groups of 4 dogs randomly selected were given the equivalent of 54.7 mg/kg/day for about four weeks and then 0.06 mg/kg/day for about 48 weeks. One dog was given a TWA dose of 79.3 mg/kg/day for a total of 246 days. Increased relative liver weight was seen in all treated groups of female guinea pigs, however, no histological changes were reported. The dog that received the TWA dose of 79.3 mg/kg/day developed fatty vacuolation and congestion in the liver and cloudy swelling and congestion in the kidneys. No effects were reported for the other groups of dogs (U.S. EPA, 1987a).

Two year dietary studies have been performed on groups of 50 male and 50 female F344 rats and B6C3F<sub>1</sub> mice (NTP, 1982; Kluwe et al., 1982). Rats were given 0, 6000, or 12,000 ppm in the diet (0, 322, 674 mg/kg/day for males; 0, 394, 774 mg/kg/day for females). Mice were given 0, 3000, or 6000 ppm in the diet (0, 672, 1325 mg/kg/day for males; 0, 799, 1821 mg/kg/day for females). Decreased body weight was observed in all treated male rats, and female rats in the high dose group, and in all treated female mice. An increased incidence of seminiferous tubule degeneration was observed at the highest dose in both rats and mice (U.S. EPA, 1987b). Renal cysts have been reported to appear in rats fed 150 mg/kg three times/week for a year, but not when the chemical is given for six months (Woodward, 1990).

One of the most commonly observed effects of *bis*(2-ethylhexyl)phthalate treatment is an increase in liver and kidney weights. The intracellular effects that accompany or account for the increase weights are an increase in the smooth endoplasmic reticulum and a proliferation in number and size of peroxisomes. Ganning et al. (1990) fed male Sprague-Dawley rats a diet containing 0.02, 0.2 or 2% *bis*(2-ethylhexyl)phthalate for 102 weeks. Decreased body weight was seen only in the 2% group, however enzyme changes that reflect the proliferation of peroxisomes occurred in a dose related manner. Peroxisomal palmitoyl-CoA dehydrogenase and mitochondrial carnitine acetyltransferase activities increased to a maximum in 20 weeks. Comparable levels were also reached in the 0.2% dose group by the end of the experiment. Peroxisomal catalase increased during the first year, but decreased to control levels during the second year of treatment. All enzyme activities returned to control values within 2-3 weeks following cessation of treatment. Peroxisomes contain a number of oxidative enzymes that affect the metabolism of the *bis*(2-ethylhexyl)phthalate and other intracellular molecules, especially fats. This proliferation of peroxisomes has been linked with carcinogenic activity (Reddy and Lalwani, 1983; Tomaszewski et al., 1986).

### 3.1.4. Developmental and Reproductive Toxicity

#### 3.1.4.1. Human

Information on developmental and reproductive toxicity of *bis*(2-ethylhexyl)phthalate in humans following oral exposure was not available.

### 3.1.4.2. Animal

A number of studies have reported fetotoxic and teratogenic effects in rats and mice following exposure to *bis*(2-ethylhexyl)phthalate. Nikonorow et al. (1973) observed increased resorption of fetal implants and decreased fetal weight when 1.7 g *bis*(2-ethylhexyl)phthalate/kg body weight was given orally on days 0-21 of gestation. Bell et al. (1979) reported decreased fetal body weights, increased relative fetal liver weights, and reduced sterologenesis in fetal brain and liver in Sprague Dawley rats fed 0.5% *bis*(2-ethylhexyl)phthalate on days 5-18 of gestation. Wolkowski-Tyl et al. (1984a) fed groups of rats 0, 0.5, 1.0, 1.5, or 2.0% *bis*(2-ethylhexyl)phthalate (equivalent to 0, 356.7, 666.4, 856.5, or 1054.8 mg/kg/day, respectively) in their diet on days 0-20 of gestation. Some maternal effects were seen, including decreased body weight, increased absolute and relative liver weight, and increased gravid uterine weight. Dose-related increases in the number of fetal resorptions and in the number of dead and malformed fetuses per litter were also reported. There was a dose-related decrease in fetal weight that was significant in all treated groups.

Wolkowski-Tyl et al. (1984b) also studied the effect of 0, 0.025, 0.05, 0.1, or 0.15% *bis*(2-ethylhexyl)phthalate (equivalent to 0, 44, 91, 191, or 292 mg/kg/day, respectively) in the diet given to mice on days 0-18 of gestation. Maternal effects observed were decreased body weight and increased relative liver weight, both effects significant at 0.1 and 0.15% in the diet. Dose-related increases in resorptions and in dead fetuses per litter were significant at doses of 0.1 and 0.15%. Significant increases in malformed fetuses per litter, with external, visceral and skeletal defects, were observed at doses of  $\geq 0.15\%$ . Studies utilizing higher oral doses (250, 500, 1000 or 2000 mg/kg) by Shiota and Mima (1985) and (0.05, 0.1, 0.2, 0.4 or 1.0% diet) by Shiota and Nishimura (1982) and Shiota et al. (1980) demonstrated increased numbers of fetuses with gross external malformations, including neural tube defects. The incidence of resorptions increased up to 100% in animals fed 0.4 and 1% *bis*(2-ethylhexyl)phthalate in their diets. Mice were shown to be most sensitive to the teratogenic effects of *bis*(2-ethylhexyl)phthalate on days 7 and 8 of gestation. Treatment on day 7 with 1 ml/kg resulted in increased fetal mortality, resorptions, and gross external and skeletal anomalies. Treatment on day 9 or 10 with up to 30 ml/kg produced no resorptions, fetal mortality or malformed fetuses (Yagi et al., 1980).

Mono(2-ethylhexyl)phthalate, a principle metabolite of *bis*(2-ethylhexyl)phthalate, was fed to pregnant CD-1 mice on days 0 through 17 of gestation (0, 0.13, 0.26, 0.48 or 0.97 mmol/kg/day). Increased maternal liver weight was observed at doses  $>0.48$  mmol/kg and decreased weight gain was observed at the 0.97 mmol dose. Dose related increased fetal mortality, the % of litters with malformed fetuses, and the % of malformed fetuses per litter were seen in all treated groups. Other metabolites including 2-ethylhexanol had no effect. Qualitatively, the effect of the monoester was similar to the diester in oral studies (Price et al., 1991).

A dose related decrease in sperm count has been reported in rats given 500 or 1000 mg/kg/day orally *bis*(2-ethylhexyl)phthalate for 15 days. Decreased epididymis weight was seen in the 1000 mg/kg/day dose group (Siddiqui and Srivastava, 1992). Decreased absolute and relative testicular weights were seen in rats given 2000 mg/kg/day orally for 15 days. A decrease in testicular 17-beta-hydroxysteroid dehydrogenase activity was observed at 1000 and 2000 mg/kg/day indicative of possible decreased steroidogenesis in treated animals (Srivastava and Srivastava, 1991). The monoester metabolite accumulates in the testes and has been shown in vitro to inhibit testicular mitochondrial respiration (Oishi, 1990).

### 3.1.5. Reference Dose

#### 3.1.5.1. Subchronic

ORAL RfD:	0.02 mg/kg/day (U.S. EPA, 1992a)
UNCERTAINTY FACTOR:	1000
LOAEL:	19 mg/kg/day

PRINCIPAL STUDIES: The same studies and comments apply to both the subchronic and chronic RfD derivations. See section 3.1.5.2.

#### 3.1.5.2. Chronic

ORAL RfD:	0.02 mg/kg/day (U.S. EPA, 1992b)
UNCERTAINTY FACTOR:	1000
MODIFYING FACTOR:	1
LOAEL:	19 mg/kg/day

CONFIDENCE:

Study:	Medium
Data Base:	Medium
RfD:	Medium

VERIFICATION DATE: 05/20/85

PRINCIPAL STUDY: Carpenter et al. (1953).

COMMENTS: The LOAEL was calculated from a 12 month experiment in which guinea pigs were given 0, 19, or 64 mg di(2-ethylhexyl)phthalate/kg body weight in the diet. The LOAEL of 19 mg/kg was based on increased relative liver weight. See section 3.1.3.2.

### 3.2. INHALATION EXPOSURES

#### 3.2.1. Acute Toxicity

##### 3.2.1.1. Human

Information on the acute inhalation toxicity of *bis*(2-ethylhexyl)phthalate in humans was not available.

##### 3.2.1.2. Animal

Rats could survive a two hour exposure to a vapor mist created by bubbling air through heated (170°C) *bis*(2-ethylhexyl)phthalate, but died after a four hour exposure (Sandmeyer and Kirwin, 1978).

#### 3.2.2. Subchronic Toxicity

##### 3.2.2.1. Human

A total of 101 workers in a *bis*(2-ethylhexyl)phthalate production plant were examined for adverse effects due to phthalate ester exposure. The air concentration of *bis*(2-ethylhexyl)phthalate ranged from 0.01 to 0.16 mg/m<sup>3</sup>, and the exposure was from four months to 35 years. Some of the chemical was found in the blood and urine of both the control and exposed groups, however, no compound-related effects were reported (Thiess et al., 1978).

### **3.2.2.2. Animal**

Information on subchronic inhalation toxicity of *bis*(2-ethylhexyl)phthalate in animals was not available.

### **3.2.3. Chronic Toxicity**

#### **3.2.3.1. Human**

No compound related effects were observed in a study of 101 workers in a *bis*(2-ethylhexyl)phthalate production plant exposed to 0.01 to 0.16 mg/m<sup>3</sup> for up to 35 years (average 12 years, see section 3.2.2.1) (Thiess et al., 1978).

Other studies have been conducted on populations chronically exposed to mixtures of phthalic acid esters containing *bis*(2-ethylhexyl)phthalate; therefore, the observed effects may or may not be caused by the *bis*(2-ethylhexyl)phthalate. Ambient air concentrations of total phthalate esters ranged from 1 to 40 mg/m<sup>3</sup> in one study (Milkov et al., 1973), and from <1 to 5 mg/m<sup>3</sup> and 5 to 60 mg/m<sup>3</sup> in a second study (Gilioli et al., 1978). These studies reported polyneuritis and mild to moderate sensory-motor and motor polyneuropathy, which increased in frequency and duration with the length of employment. The Milkov et al. (1973) study also reported decreased vestibular and olfactory excitability and decreased thrombocytes, leukocytes, and hemoglobin in some exposed individuals. No effects were reported by Gilioli et al. (1978) in populations employed less than two years.

#### **3.2.3.2. Animal**

Information on the chronic inhalation toxicity of *bis*(2-ethylhexyl)phthalate in animals was not available.

### **3.2.4. Developmental and Reproductive Toxicity**

#### **3.2.4.1. Human**

No increase in the incidence of miscarriages or offspring deformities was seen in female workers or in the wives of male workers in a study of 101 employees at a *bis*(2-ethylhexyl)phthalate production facility with exposures of 0.01 to 0.16 mg/m<sup>3</sup> for up to 35 years (average 12 years, see section 3.2.2.1) (Thiess et al., 1978).

#### **3.2.4.2. Animal**

Information on developmental and reproductive toxicity in animals resulting from inhalation exposure to *bis*(2-ethylhexyl)phthalate was not available.

### **3.2.5. Reference Concentration**

#### **3.2.5.1. Subchronic**

A subchronic Reference Concentration is not available at this time.

#### **3.2.5.2 Chronic**

A chronic Reference Concentration is not available at this time.



### **3.3. OTHER ROUTES OF EXPOSURE**

#### **3.3.1. Acute Toxicity**

##### **3.3.1.1. Human**

*Bis*(2-ethylhexyl)phthalate is mildly irritating to the skin and irritating to the eyes and mucous membranes on contact (Sittig, 1985; Sax and Lewis, 1989). Humans are also susceptible to introduction of *bis*(2-ethylhexyl)phthalate by intravenous route since this substance is known to leach from blood containers and other PVC plastic medical equipment. However, no reports describing acute adverse effects as a result of this route of exposure are available.

##### **3.3.1.2. Animal**

*Bis*(2-ethylhexyl)phthalate can be absorbed through the skin and LD<sub>50</sub> values of 25 and 10 g/kg have been listed for rabbits and guinea pigs, respectively. A dose of 500 mg/24 hours is mildly irritating to the skin and eyes of rabbits (Sax and Lewis, 1989).

#### **3.3.2. Subchronic Toxicity**

##### **3.3.2.1. Human**

Information on the subchronic toxicity of *bis*(2-ethylhexyl)phthalate by other routes of exposure in humans was unavailable.

##### **3.3.2.2. Animal**

Information on the subchronic toxicity of *bis*(2-ethylhexyl)phthalate by other routes of exposure in animals was unavailable.

#### **3.3.3. Chronic Toxicity**

##### **3.3.3.1. Human**

Humans needing chronic transfusions of blood are susceptible to the introduction of *bis*(2-ethylhexyl)phthalate by intravenous route since this substance is known to leach from blood containers and other PVC plastic medical equipment (Sittig, 1985). The diester leached from the plastic can be metabolized to the monoester by blood enzymes. The monoester has been shown to inhibit platelet phospholipase A2 possibly resulting in reduced platelet function (Labow et al., 1988). Long term hemodialysis patients often develop renal cysts similar to that reported for rats chronically exposed to *bis*(2-ethylhexyl)phthalate, however, a causal relationship has not been shown with leached plasticizer (Woodward, 1990). No reports specifically describing adverse effects as a result of this route of exposure were located.

##### **3.3.3.2. Animal**

Information on the chronic toxicity of *bis*(2-ethylhexyl)phthalate by other routes of exposure in animals was unavailable.

### **3.3.4. Developmental and Reproductive Toxicity**

#### **3.3.4.1. Human**

Information on the developmental and reproductive toxicity of *bis*(2-ethylhexyl)phthalate by other routes of exposure in humans was unavailable.

#### **3.3.4.2. Animal**

Male and female mice were given subcutaneous injections of 1 to 100 ml *bis*(2-ethylhexyl)phthalate/kg on days 1, 5, and 10 and evaluated on day 21 of the experiment for reproductive performance, biochemical parameters of the gonads and histological alterations. Decreased numbers of pregnancies were reported when either sex of treated mice were mated with untreated mice. Decreased testicular weight but not ovarian weight was reported. Histological damage and increased lysosomal activity was seen in both sexes. Decreased fertility was the most sensitive indicator for gonadotoxicity (Agarwal et al., 1989).

In addition to the monoester derivative of *bis*(2-ethylhexyl)phthalate, another principal metabolite, 2-ethylhexanoic acid, exists in two enantiomeric forms. The S enantiomer was found to not be embryotoxic or teratogenic. However, intraperitoneal injection of pregnant rats with 500 mg/kg twice daily on day 7 and 8 of gestation with the R enantiomer caused decreased fetal survival, decreased weight of surviving fetuses, and neural tube defects in 59% of living fetuses (Hauck et al., 1990).

### **3.4. TARGET ORGANS/CRITICAL EFFECTS**

#### **3.4.1. Oral Exposures**

##### **3.4.1.1. Primary Target Organ(s)**

1. Liver: Increased liver weight was observed in animals following oral treatment with *bis*(2-ethylhexyl)phthalate.
2. Kidney: Increased kidney weight was observed in animals following oral treatment with *bis*(2-ethylhexyl)phthalate.

##### **3.4.1.2. Other Target Organ(s)**

1. Fetus: Exposure to *bis*(2-ethylhexyl)phthalate during gestation has resulted in increased fetal mortality and malformations in rats and mice.
2. Testis: Treatment with *bis*(2-ethylhexyl)phthalate has resulted in decreased testicular weight and degeneration of the seminiferous tubules in rats and mice.
3. Blood: Decreased hemoglobin and packed cell volume was observed in rats exposed to *bis*(2-ethylhexyl)phthalate.

#### **3.4.2. Inhalation Exposures**

##### **3.4.2.1. Primary Target Organ(s)**

1. Blood: Decreased hemoglobin and blood cell counts were observed in humans exposed to a mixture of phthalate esters containing *bis*(2-ethylhexyl)phthalate.

2. Nervous system: A polyneuritis and mild to moderate sensory-motor and motor polyneuropathy were observed in humans exposed to a mixture of phthalate esters containing *bis*(2-ethylhexyl)phthalate.

#### **3.4.2.2. Other Target Organ(s)**

1. Liver: The effects on liver are likely to be independent of route of exposure.
2. Kidney: The effects on kidney are likely to be independent of route of exposure.

### **4. CARCINOGENICITY**

#### **4.1. ORAL EXPOSURES**

##### **4.1.1. Human**

Information on the oral carcinogenicity of *bis*(2-ethylhexyl)phthalate in humans was unavailable.

##### **4.1.2. Animal**

Groups of 50 male and 50 female Fisher 344 rats were given 0, 6000, or 12000 ppm *bis*(2-ethylhexyl)phthalate in their diet for 103 weeks. Groups of 50 male and 50 female B6C3F<sub>1</sub> mice were given 0, 3000, or 6000 ppm of the chemical in their diets for 103 weeks. All animals were examined when moribund or after 105 weeks from the beginning of treatment. No clinical signs of toxicity were observed in any of the animals. Female rats, and male and female mice demonstrated a statistically significant dose-dependent increased incidence of hepatocellular carcinomas and combined carcinomas and adenomas. A significant increase in the combined incidence of neoplastic nodules and hepatocellular carcinomas was seen in the high-dose male rats (NTP, 1982; Kluwe, et al., 1982).

Combined neoplastic nodules and hepatocellular carcinomas ranging from 0 to 4 per liver were reported in 11 of 14 F-344 rats on a diet containing 2% *bis*(2-ethylhexyl)phthalate for 108 weeks (Rao et al., 1990).

*Bis*(2-ethylhexyl)phthalate is known to induce the production of peroxisomes and the proliferation of peroxisomes has been linked with carcinogenesis (Rao and Reddy, 1991) (See also section 3.1.3.2.).

#### **4.2. INHALATION EXPOSURES**

##### **4.2.1. Human**

Information on the inhalation carcinogenicity of *bis*(2-ethylhexyl)phthalate in humans was unavailable.

##### **4.2.2. Animal**

Information on the inhalation carcinogenicity of *bis*(2-ethylhexyl)phthalate in animals was unavailable.

#### **4.3. OTHER ROUTES OF EXPOSURE**

Information on the carcinogenicity of *bis*(2-ethylhexyl)phthalate in animals or humans with other routes of exposure was unavailable.

#### 4.4. EPA WEIGHT-OF-EVIDENCE

##### 4.4.1. Oral

CLASSIFICATION: Group B2 -- Probable Human Carcinogen (U.S. EPA, 1987a, 1987b, 1991a, 1991b).

BASIS: Based on an increased incidence of hepatocellular carcinomas and adenomas in both rats and mice treated with *bis*(2-ethylhexyl)phthalate in the diet (NTP, 1982; Kluwe, et al., 1982).

##### 4.4.2. Inhalation

CLASSIFICATION: Group B2 -- Probable Human Carcinogen (U.S. EPA, 1987a, 1992a, 1992b).

BASIS: Based on an increased incidence of hepatocellular carcinomas and adenomas in both rats and mice treated with *bis*(2-ethylhexyl)phthalate in the diet (NTP, 1982; Kluwe, et al., 1982).

#### 4.5. CARCINOGENICITY SLOPE FACTORS

##### 4.5.1. Oral

SLOPE FACTOR:	1.4E-2 (mg/kg/day) <sup>-1</sup> (U.S. EPA, 1992a, 1992b)
DRINKING WATER UNIT RISK:	4.0E-7 (μg/L) <sup>-1</sup> (U.S. EPA, 1992a, 1992b)
VERIFICATION DATE:	7/10/87
PRINCIPAL STUDY:	NTP (1982); Kluwe, et al. (1982).

COMMENTS: Based on incidence of hepatocellular carcinomas and adenomas in male mice exposed orally to *bis*(2-ethylhexyl)phthalate. Both listed references discuss the same data set.

##### 4.5.2. Inhalation

Quantitative estimation of carcinogenic risk from inhalation exposure is not available (U.S. EPA, 1992b)

#### 5. REFERENCES

- Agarwal, D.K., W.H. Lawrence, J.E. Turner and J. Autian. 1989. Effects of parenteral di(2-ethylhexyl)phthalate (DEHP) on gonadal biochemistry, pathology, and reproductive performance of mice. *J. Toxicol Environ. Health.* 26(1): 39-59.
- Albro, P.W., R.E. Chapin, J.T. Corbett, J. Schroeder and J.L. Phelps. 1989. Mono-2-ethylhexyl phthalate, a metabolite of di(2-ethylhexyl)phthalate, causally linked to testicular atrophy in rats. *Toxicol Appl. Pharmacol.* 100(2): 193-200.
- Albro, P.W., J.T. Corbett, J.L. Schroeder, S. Jordan and H. B. Matthews. 1982. Pharmacokinetics, interactions with macromolecules and species differences in metabolism of DEHP. *Environ. Health Perspect.* 45:19-25.
- Autian, J. 1973. Toxicity and health threats of phthalate esters: Review of the literature. *Environ. Health Perspect.* 4: 3-26.

- Barron, M.G., I.R. Schultz and W.L. Hayton. 1989. Presystemic branchial metabolism limits di(2-ethylhexyl)phthalate accumulation in fish. *Toxicol. Appl. Pharmacol.* 98(1): 49-57.
- Bell, F.P., M. Makowske, D. Schneider and C.S. Patt. 1979. Inhibition of sterologenesis in brain and liver of fetal and suckling rats from dams fed di(2-ethylhexyl)phthalate plasticizer. *Lipids*. 14(4): 372-377.
- Budavari S., M.J. O'Neil, A. Smith and P.E. Heckelman, Eds. 1989. *The Merck Index*. 11th ed. Merck and Co., Rahway, NJ. p. 194.
- Callahan, M.A., M.W. Slimak, N.W. Gabel, et al. 1979. Fate of 129 Priority Pollutants. Vol. II. Office of Water Planning and Standards, U.S. EPA, Washington, DC. p. (94)1-28.
- Carpenter, G.P., C.S. Weil and H.F. Smyth, Jr. 1953. Chronic oral toxicity of di(2-ethylhexyl)phthalate for rats, guinea pigs and dogs. *J. Ind. Hyg. Occup. Med.* 18: 219-226
- Chawla, A.S. and I. Hinberg. 1991. Leaching of plasticizers from and surface characterization of PVC blood platelet bags. *Biomater. Artif. Cells. Immobil. Biotechnol.* 19(4): 761-784.
- Davey, E.W., K.T. Perez, A.E. Soper, N.F. Lackie, G.E. Morrison, R.L. Johnson and J.F. Heltshe. 1990. Significance of the surface microlayer to the environmental fate of di(2-ethylhexyl)phthalate predicted from marine microcosms. *Mar. Chem.* 31(4): 231-270.
- Elsisi, A.E., D.E. Carter and I.G. Sipes. 1989. Dermal absorption of phthalate diesters in rats. *Fund. appl. Toxicol.* 12(1): 70-77.
- Ganning, A.E., M.J. Olsson, U. Brunk and G. Dallner. 1990. Effects of prolonged treatment with phthalate ester on rat liver. *Pharmacol Toxicol.* 67(5): 392-401.
- Gilioli, R., C. Bulgheroni, T. Terrano, G. Filippini, G. Massetto and R. Boeri. 1978. Studio neurologico transvervale e longitudinale di una popolazione operaia addetta alla produzione di ftalati. *Med. Lav.* 69(5): 620-631 (cited in U.S. EPA, 1987a).
- Gray, T.J.B., K.R. Butterworth, I.F. Gaunt, P. Grasso and S.D. Gangolli. 1977. Short-term toxicity study of di(2-ethylhexyl)phthalate in rats. *Food Cosmet. Toxicol.* 15(5): 389-400.
- Hauck, R.S., C. Wegner, P. Blumtritt, J.H. Fuhrhop and H. Nau. 1990. Asymmetric synthesis and teratogenic activity of (R)- and (S)-2-ethylhexanoic acid, a metabolite of the plasticizer di(2-ethylhexyl)phthalate. *Life Sci.* 46(7): 513-518.
- Kluwe, W.M., J. K. Haseman, J.F. Douglas and J.E. Huff. 1982. The carcinogenicity of dietary di(2-ethylhexyl)phthalate (DEHP) in Fischer 344 rats and B6C3F1 mice. *J. Toxicol. Environ. Health.* 10(4-5): 797-815.
- Labow, R.S., E. Meek, G.A. Adams and G. Rock. 1988. Inhibition of human platelet phospholipase A2 by mono(2-ethylhexyl)phthalate. *Environ. Health. Perspect.* 78: 179-183.
- Lake, B.G., P.G. Brantom, S.D. Gangolli, K.R. Butterworth and P. Grasso. 1976. Studies on the effects of orally administered *bis*(2-ethylhexyl)phthalate in the ferret. *Toxicology.* 6(3): 341-356.
- Matsuda, K. and M. Schnitzer. 1971. Reactions between fulvic acid, a soil humic material, and dialkyl phthalates. *Bull. Environ. Contam. Toxicol.* 6: 200-204.

Milkov, L.B., M.V. Aldjreva, T.B. Popova, et al. 1973. Health status of workers exposed to effect of phthalate plasticizers in the production of artificial leather and films (on the basis of PVC resins). Translation of Gig. Tr. Prof Zabol. 13: 14-17, 1969. NTIS PB221973-T. 5 p. (cited in U.S. EPA, 1987a).

Nagasaki, H., S. Tomii, T. Mega, K. Hirao and I. N. Yoshitaka. 1974. Chronic toxicity of dioctyl phthalate (DOP) in male rats and mice. Nara Igaku Zasshi. 25(6): 649-654 (cited in U.S. EPA, 1987b).

Nagasaki, H., L. Tomii, T. Mega, K. Hirao and I.N. Yoshitaka. 1974. Chronic toxicity of dioctyl phthalate (DOP) in male rats and mice. Nara Igaku Zasshi. 25(6): 649-654. (cited in U.S. EPA, 1987a and b).

Nikonorow, M., H. Mazur and H. Piekacz. 1973. Effects of orally administered plasticizers and polyvinyl chloride stabilizers in the rat. Toxicol. Appl. Pharmacol. 26: 253-259.

NTP (National Toxicology Program). 1982. Carcinogenesis bioassay of di(2-ethylhexyl)phthalate (CAS No. 117-81-7) in F344 rats and B6C3F<sub>1</sub> mice (feed study). Report NIH/PUB-82-1773, NTP-80-37. NTIS PB82-184011. (cited in U.S. EPA, 1987a and b).

Oishi S. 1990. Effects of phthalic acid esters on testicular mitochondrial functions in the rat. Arch Toxicol. 64(2): 143-147.

Oishi, S and Hiraga. 1982. Distribution and elimination of di-2-ethylhexyl phthalate and mono-2-ethylhexyl phthalate after a single oral administration of di-2-ethylhexyl phthalate in rats. Arch. Toxicol. 51(2):149-156.

Ota, H., H. Onda, H. Kodama and N. Yamada. 1974. Histopathological studies on the effect of phthalic acid esters on the biological system of mice. Nippon Eiseigaku Zasshi. 29(5): 519-524. (cited in U.S. EPA, 1987b).

Pegg, D.G. 1982. Disposition of di(2-ethylhexyl)phthalate following inhalation and peroral exposure in rats. OTS 8(d) submission. Microfiche no. 0206189. (cited in U.S. EPA, 1987a).

Pollack, G.M., R.C.K. Li, J.C. Ermer and D.D. Shen. 1985. Effects of route of administration and repetitive dosing on the disposition kinetics of di(2-ethylhexyl)phthalate and its mono de-esterified metabolite in rats. Toxicol. Appl. Pharmacol. 79(2): 246-256.

Price, C.J., R.W. Tyl, M.C. Marr, C.B. Myers, R.E. Morrissey, J.J. Heindel and B.A. Schwetz. 1991. Developmental toxicity evaluation of DEHP metabolites in Swiss mice. Teratology. 43(5): 457.

Rao, M.S. and J. K. Reddy. 1991. An overview of peroxisome proliferator-induced hepatocarcinogenesis. Environ. Health Perspect. 93: 205-209.

Rao, M.S., A.V. Yeldandi and V. Subbarao. 1990. Quantitative analysis of hepatocellular lesions induced by di(2-ethylhexyl)phthalate in F-344 rats. J. Toxicol Environ Health. 30(2): 85-89.

Reddy, J. K. and N.D. Lalwani. 1983. Carcinogenesis by hepatic peroxisome proliferators: evaluation of the risk of hypolipidemic drugs and industrial plasticizers to humans. CRC Crit. Rev. Toxicol. 12: 1-58.

Sandmeyer, E.E. and C.J. Kirwin, Jr. 1978. Esters. In Patty's Industrial Hygiene and Toxicology, Vol. 2A, eds. G.D. Clayton and F.E. Clayton, John Wiley & Sons, New York. pp. 2342-2352.

Sax, N.I., and R.J. Lewis. 1989. Dangerous Properties of Industrial Materials. 7th ed. Vol. II. Van Nostrand Reinhold, New York.

Schmid, P. and C. Schlaffer. 1985. Excretion and metabolism of di(2-ethylhexyl)phthalate in man. *Xenobiotica*. 15(3):251-256 (cited in U.S. EPA, 1987b)

Shaffer, C.B., C.P. Carpenter and H.F. Smyth. 1945. Acute and subacute toxicity of di(2-ethylhexyl)phthalate with note upon its metabolism. *J. Ind. Hyg. Toxicol.* 27: 130.

Shiota, K., M.J. Chou and H. Nishimura. 1980. Embryotoxic effects of di(2-ethylhexyl)phthalate and di-n-butyl phthalate in mice. *Environ. Res.* 22(1): 245-253 (cited in U.S. EPA, 1987b).

Shiota, K. and S. Mima. 1985. Assessment of the teratogenicity of di(2-ethylhexyl)phthalate and mono(2-ethylhexyl) phthalate in mice. *Arch. Toxicol.* 56(4): 263-266 (cited in U.S. EPA, 1987b).

Shiota, K. and H. Nishimura. 1982. Teratogenicity of di(2-ethylhexyl)phthalate and di-n-butyl phthalate in mice. *Environ. Health Perspect.* 45: 65-70.

Siddiqui, A. and S.P. Srivastava. 1992. Effect of di(2-ethylhexyl)phthalate administration on sperm count and on sperm metabolic enzymes. *Bull. Environ. Contam. Toxicol.* 48(1): 115-119.

Sittig, M. 1985. Di(2-ethylhexyl)phthalate. in: *Handbook of Toxic and Hazardous Chemicals and Carcinogens*, Second Ed. Noyes publications, Park Ridge, New Jersey. pp. 345-346.

Srivastava, S. and S.P. Srivastava. 1991. Effect of di(2-ethylhexyl)phthalate on 17beta-hydroxysteroid dehydrogenase activity in testis of rat. *Toxicology Letters*. 57(2): 235-239.

Sullivan, K.F., E.L. Atlas and C.S. Giam. 1982. Adsorption of phthalic acid esters from seawater. *Environ. Sci. Technol.* 16: 428-432.

Teirlynck, O.A. and J. Belpaire. 1985. Disposition of orally administered di(2-ethylhexyl)phthalate and mono(2-ethylhexyl)phthalate in the rat. *Arch. Toxicol.* 57(4):226-230

Thiess, A.M., A. Korte and H. Fleig. 1978. Studies on morbidity in workers exposed to di(2-ethylhexyl)phthalate. *Moeglichkeiten Grenzen Biol. Monit./Arbeitsmed. Probl. Dienstleistungsgewerbes/Arbeitsmed. Kolloq., Ber. Jahrestag.* 18: 137-154 (cited in U.S. EPA, 1987a).

Tomaszewski, D.E., D.K. Agarwal and R.L. Melnick. 1986. In vitro steady-state levels of hydrogen peroxide after exposure of male F344 rats and female B6C3F<sub>1</sub> mice to hepatic peroxisome proliferators. *Carcinogenesis* 7(11): 1871-1876.

U.S. EPA. 1980. Ambient Water Quality Criteria for Phthalate Esters. Prepared by the Office of Research and Development, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Water Regulations and Standards, Criteria and Standards Division, Washington, DC.

U.S. EPA. 1987a. Health Effects Assessment for Selected Phthalic Acid Esters, Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response, Washington, DC.

U.S. EPA. 1987b. Health and Environmental Effects Profile for Phthalic Acid Alkyl, Aryl and Alkyl/Aryl Esters, Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response, Washington, DC.

U.S. EPA. 1992a. Health Effects Assessment Summary Tables, Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington, DC.

U.S. EPA. 1992b. Integrated Risk Information System (IRIS). Health Risk Assessment for Carbon Tetrachloride. OnLine. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH.

Vainiotalo, S. and P. Pfaffli. 1990. Air impurities in the PVC plastics industry. *Ann. Occ. Hyg.* 34(6):585-590.

Williams, D.T. and B.J. Blanchfield. 1974. Retention, excretion and metabolism of *bis*(2-ethylhexyl)phthalate administered orally to the rat. *Bull. Environ. Contam. Toxicol.* 11(4): 371-378.

Wolkowski-Tyl, R, C. Jones-Price and M.C. Marr. 1984a. Teratologic evaluation of diethylhexyl phthalate (CAS No. 117-81-7) in Fischer 344 rats. *Gov. Rep. Announce. Index.* 85(2): 70 (cited in U.S. EPA, 1987b).

Wolkowski-Tyl, R, C. Jones-Price, M.C. Marr and C.A. Kimmel. 1984b. Teratologic evaluation of diethylhexyl phthalate (CAS No. 117-81-7) in CD-1 mice. *Gov. Rep. Announce. Index.* 85(2): 70 (cited in U.S. EPA, 1987b).

Woodward, K. N. 1990. Phthalate esters, cystic kidney disease in animals and possible effects on human health: a review. *Human and Exp. Toxicol.* 9(6): 397-401.

Yagi, Y., Y. Nakamura, I. Tomita, K Tsuchikawa and N. Shimoi. 1980. Teratogenic potential of di- and mono-(2-ethylhexyl)phthalate in mice. *J. Environ. Pathol. Toxicol.* 4(2-3): 533-544 (cited in U.S. EPA, 1987b).



**TOXICITY SUMMARY FOR  
CHLORDANE**

December 1994

Prepared by

Carol S. Forsyth, Ph.D.  
Chemical Hazard Evaluation Group  
Biomedical and Environmental Information Analysis Section  
Health Sciences Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for

U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Technology Demonstration and Transfer Branch  
Environmental Technology Division  
U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

---

\*Managed by Martin Marietta Energy Systems Inc., for the U.S. Department of Energy under  
Contract No. DE-AC05-84OR21400

## EXECUTIVE SUMMARY

Technical grade chlordane is a mixture of structurally related compounds including *trans*-chlordane, *cis*-chlordane,  $\beta$ -chlordene, heptachlor, and *trans*-nonachlor (ATSDR, 1994). Chlordane was used extensively as a pesticide in the United States from 1948 to 1988. Because the chemical is persistent in the environment, exposure can still occur from breathing the air of treated homes, consuming shellfish caught in contaminated waters, or eating food produced on contaminated farmlands (ATSDR, 1994). Chlordane is readily absorbed after oral, inhalation, or dermal exposure and is stored in adipose tissue. The chemical is excreted in the feces from the bile (Ewing et al., 1985), but metabolite residues have been detected in 46% of human milk samples from Arkansas/Mississippi, in 68% of samples from Mississippi, and in 100% of samples from Hawaii (ATSDR, 1994).

Death in humans from ingestion of chlordane was accompanied by vomiting, dry cough, agitation and restlessness, hemorrhagic gastritis, bronchopneumonia, muscle twitching, and convulsions (IARC, 1991). Nonlethal, accidental poisoning of children has resulted in convulsions, excitability, loss of coordination, dyspnea, and tachycardia; however, recovery was complete (IARC, 1991). When a municipal water supply was contaminated with chlordane in concentrations of up to 1.2 g/L, 13 persons had symptoms of gastrointestinal and neurological disorders (WHO, 1984). Signs of toxicity from chronic inhalation exposure in chlordane treated homes include sinusitis, bronchitis, dermatitis, neuritis, migraine (Menconi et al., 1988), gastrointestinal distress, fatigue, memory deficits, personality changes, decreased attention span, numbness or paresthesias, disorientation, loss of coordination, dry eyes, and seizures (Spyker et al., 1990). Blood dyscrasias, including production defects and thrombocytopenic purpura, have been described for both professional applicators and for home owners and their families following home termite treatment (Epstein and Ozonoff, 1987). An inhalation reference concentration (RfC) for chlordane is under review by EPA (U.S. EPA 1994a).

Liver enlargement occurred in mice exposed to 10 mg/m<sup>3</sup> 8 hours/day, 5 days/week for 90 days (IARC, 1991). Increased liver weights were found in female rats (5.8 mg/m<sup>3</sup>), increased liver and kidney weights occurred in male rats (28.2 mg/m<sup>3</sup>), serum chemistry changes indicative of liver damage and hypersensitivity occurred in females (28.2 mg/m<sup>3</sup>), and centrilobular hepatocyte enlargement occurred in males and females (28.2 mg/m<sup>3</sup>) exposed to chlordane by inhalation 8 hours/day, 5 days/week, for 28 days (ATSDR, 1994).

Long-term feeding studies with chlordane in laboratory animals resulted in significantly reduced weight gains in male (203.5 or 407.0 ppm; 80 weeks) and female (120.8 or 241.5 ppm; 80 weeks) rats, a dose-related trend in mortality of female rats and male mice (29.9 or 56.2 ppm; 80 weeks) (NCI, 1977), and liver hypertrophy of female rats ( $\geq 5$  ppm; 130 weeks) (U.S. EPA, 1994a). In a 24-month feeding study with mice, hepatocellular swelling and necrosis occurred in males and increased liver weights occurred in males and females fed 5 ppm (ATSDR, 1994; U.S. EPA, 1994a). A chronic oral reference dose (RfD) of 6E-05 mg/kg/day for chlordane was calculated from a no-observed-adverse-effect level (NOAEL) of 0.055 mg/kg/day derived from a chronic feeding study with rats (U.S. EPA, 1994a). The subchronic oral RfD is also 6E-05 mg/kg/day (U.S. EPA, 1994b).

Altered endocrine (Cranmer et al., 1984) and immune (Shepard, 1983; Theus et al., 1991) functions have been observed in rat pups exposed to chlordane in utero.

Exposure of humans from chlordane treated homes has been associated with leukemia (Epstein and Ozonoff, 1987), skin neoplasms (Menconi et al., 1988), and neuroblastoma in children (IARC, 1991). An increased risk of non-Hodgkin's lymphoma has been found among farmers exposed to chlordane 20 or more days per year (Hoar Zahm et al., 1988). Hepatic carcinomas and hepatocellular adenomas have been described for several strains of male and female mice and male rats given chlordane in the diet (NCI, 1977; U.S. EPA, 1994a). U.S. EPA (1994a) has classified chlordane as group B2, probable human carcinogen. The carcinogenicity slope factor ( $q_1^*$ ) for oral exposure is 1.3E+0 (mg/kg/day)<sup>-1</sup> based on an increase of hepatocellular carcinomas in mice and hepatocellular adenomas in rats. A drinking water unit risk of 3.7E-5 ( $\mu\text{g/L}$ )<sup>-1</sup> was calculated based on the  $q_1^*$  (U.S. EPA, 1994a). The  $q_1^*$  for inhalation exposure is 1.3E+0 (mg/kg/day)<sup>-1</sup> (U.S. EPA, 1994b) and the inhalation unit risk value is 3.7E-4 ( $\mu\text{g/m}^3$ )<sup>-1</sup> (U.S. EPA, 1994a). The inhalation risk estimates were calculated from the oral data.

## 1.0 INTRODUCTION

Chlordane ( $C_{10}H_6Cl_8$ ; CAS registry number 57-94-9) is a viscous, amber-colored liquid with a molecular weight of 409.8 (Budavari et al., 1989). Technical grade chlordane is a mixture of many structurally related compounds including *trans*-chlordane, *cis*-chlordane,  $\beta$ -chlordene, heptachlor, and *trans*-nonachlor (ATSDR, 1994). The man-made chemical was used as a broad-spectrum pesticide in the United States from 1948 to 1988 and is often referred to by the trade names Octachlor and Velsicol 1068 (ATSDR, 1994). Uses included termite control in homes; pest control on agricultural crops such as maize and citrus; and pest control on home lawns and gardens, turf, and ornamental plants (IARC, 1991).

In the environment, chlordane is persistent and not readily degraded in water or soil. The chemical can volatilize from surface waters into the atmosphere but adsorbs strongly to soils. Chlordane accumulates in the fat of fish, birds, mammals, and humans (ATSDR, 1994).

## 2.0 METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

Chlordane is readily absorbed after oral, inhalation, or dermal exposure. Blood levels in children after ingestion of unknown amounts have been measured at 2.71 to 3.4 mg/L (ATSDR, 1994). Peak blood levels in rats (81 ng/mL) and mice (113 ng/mL) occurred 2 and 8 hours, respectively, following oral administration of 1 mg/kg (Ewing et al., 1985). Data from humans exposed to chlordane in the air of treated homes indicates that blood or tissue levels increase with duration of exposure (ATSDR, 1994). Absorption through the skin of monkeys accounted for 4.2% of the dose in soil (ATSDR, 1994). Chlordane has been detected more frequently in the blood (mean of 2.2 ppm) of pesticide applicators who wore respirators than those not wearing respirators, indicating that dermal absorption is important because applicators wearing respirators tended to spray much larger amounts of the chemical (Saito et al., 1986).

### 2.2. DISTRIBUTION

In rats, one day after a single oral dose of chlordane ranging from 0.05-1.0 mg/kg, the greatest concentration of the chemical was found in adipose tissue, followed by liver, kidney, brain, and muscle (ATSDR, 1994). Because of its lipophilicity, chlordane accumulates in fat with the amount of accumulation dependent on duration of exposure (ATSDR, 1994). Rats fed chlordane at 1, 5, or 25 mg/kg for 56 days had fat residues 3 times higher than the dietary concentrations (WHO, 1984). Ewing et al. (1985) determined tissue concentrations of chlordane in mice and rats treated orally with 1 mg/kg. Peak concentrations in mice occurred at 4 hours and were 808, 1180, 349, 68, and 164 ng/g for fat, liver, kidney, brain, and muscle, respectively. Rats had peak tissue concentrations of 1239 and 729 ng/g for fat and kidney, respectively, at 4 hours and of 1959, 221, and 130 ng/g for liver, brain, and muscle, respectively, at 2 hours. Chlordane concentrations of 0.005 - 0.137 mg/kg have been measured in human placenta (Al-Omar et al., 1986) indicating that distribution to the fetus is possible. Chlordane has also been detected in human milk (Giroux et al., 1992).

### 2.3. METABOLISM

Four metabolic pathways have been proposed for the metabolism of chlordane: 1) hydroxylation followed by dehydration to form the precursor of oxychlordane; 2) dehydrochlorination to form heptachlor with the subsequent formation of heptachlor epoxide; 3) dechlorination, and; 4) replacement of chlorine atoms by hydroxyl groups to form metabolites that are excreted or conjugated with glucuronic acid (IARC, 1991). The major metabolite of chlordane in humans is oxychlordane, which has been detected in the blood of pesticide applicators (Saito et al., 1986). Dearth and Hites (1991) determined that the nonachloro- and

pentachlorocyclopentene components of chlordane were preferentially accumulated in human adipose tissue suggesting that people are unable to metabolize these isomers.

## **2.4. EXCRETION**

The major route of chlordane excretion is in the feces; however, of more importance is elimination in human milk. Chlordane had been detected in the urine and feces of humans following accidental ingestion of the chemical (ATSDR, 1994). Mice and rats given a single oral dose of 1 mg/kg, eliminated 34% and 7%, respectively, in the feces by 12 hours; by 3 days, both species had eliminated 83% of the dose in the feces. Biliary excretion appears to be the source of fecal excretion (Ewing et al., 1985). Oxychlordane residues have been detected in 46% of human milk samples from Arkansas/Mississippi, in 68% of samples from Mississippi, and in 100% of samples from Hawaii (ATSDR, 1994). Al-Omar et al. (1986) monitored chlordane residues in human milk over a 5-month period. Concentrations of the chemical varied from below the limit of detection to a high of 0.310 mg/kg whole milk throughout the entire study.

## **3. NONCARCINOGENIC HEALTH EFFECTS**

### **3.1. ORAL EXPOSURES**

#### **3.1.1. Acute Toxicity**

##### **3.1.1.1. Human**

The acute lethal dose of chlordane to humans has been estimated to be 25-50 mg/kg (WHO 1984). A woman died 9.5 days after ingestion of about 6 g of a 5% formulation (104 mg/kg). Signs of toxicity included vomiting, dry cough, agitation and restlessness, hemorrhagic gastritis, bronchopneumonia, muscle twitching, and convulsions (IARC, 1991). Accidental poisoning of children by ingestion of nonlethal amounts of chlordane has resulted in convulsions, excitability, loss of coordination, dyspnea, and tachycardia; however, recovery was complete (IARC, 1991). When a municipal water supply was contaminated with chlordane at concentrations of up to 1.2 g/L, 13 persons had symptoms of gastrointestinal and neurological disorders (WHO, 1984).

##### **3.1.1.2. Animal**

Oral LD<sub>50</sub> values for technical grade chlordane in the rat range from 137 to 590 mg/kg (ATSDR, 1994). However, the LD<sub>50</sub> for the rabbit is 1720 mg/kg (WHO, 1984). Signs of acute chlordane intoxication include ataxia, convulsions, and cyanosis followed by death due to respiratory failure (WHO, 1984). Rats treated by gavage with 100 mg/kg once a day for 4 days had increased absolute liver weights, fatty infiltration of the liver, and increased serum triglycerides, creatine phosphokinase, and lactic acid dehydrogenase (Ogata and Izushi, 1991). Sheep treated by stomach tube with 500 mg/kg showed signs of intoxication but recovered fully within 5-6 days; 1000 mg/kg resulted in death after 48 hours (WHO, 1984).

#### **3.1.2. Subchronic Toxicity**

##### **3.1.2.1. Human**

Information on the subchronic oral toxicity of chlordane in humans was not available.

### **3.1.2.2. Animal**

Male and female rats and mice were given chlordane in the diet for 6 weeks (NCI, 1977). All male rats fed 1600 ppm died after 2 weeks but no effects were seen at 800 ppm; however, 4 of 5 female rats died at 800 ppm with no effects seen at 400 ppm. Two of 5 male mice and all females died when fed 320 ppm; no effects were seen in either sex of mice at 80 ppm.

### **3.1.3. Chronic Toxicity**

#### **3.1.3.1. Human**

Information on the chronic oral toxicity of chlordane to humans was not available.

#### **3.1.3.2. Animal**

Male and female rats and mice were given chlordane in the diet for 80 weeks (NCI, 1977). Doses were calculated as time-weighted averages with male rats receiving 203.5 or 407.0 ppm, female rats receiving 120.8 or 241.5 ppm, male mice receiving 29.9 or 56.2 ppm, and female mice receiving 30.1 or 63.8 ppm. All treated animals were in generally poor physical condition at the end of the study with significantly reduced weight gains measured in both sexes of rats. For female rats and male mice, there was a dose-related trend in mortality. No effect on mortality was observed in male or female rats fed chlordane at concentrations of 1, 5, or 25 ppm for 130 weeks but females had liver hypertrophy at  $\geq 5$  ppm (U.S. EPA, 1994a). In a 24-month feeding study with mice, hepatocellular swelling and necrosis occurred in males and increased liver weights occurred in males and females fed 5 ppm (ATSDR, 1994; U.S. EPA, 1994a). Dogs fed chlordane at doses of 0.3, 3, 15, or 30 mg/kg for 2 years had abnormal clinical liver function tests (not defined) at the two highest concentrations and a dose-related increase in liver weight (WHO, 1984).

### **3.1.4. Developmental and Reproductive Toxicity**

#### **3.1.4.1. Human**

Information on the developmental or reproductive toxicity of chlordane to humans following oral exposure was not available.

#### **3.1.4.2. Animal**

No histopathological lesions were observed in reproductive tracts of male (407 ppm) or female (241.5 ppm) rats or in male (56.2 ppm) or female (63.8 ppm) mice given chlordane in the diet for 80 weeks (NCI, 1977).

No malformations or fetal toxicity were seen in offspring from rats administered up to 80 mg/kg/day chlordane by gavage during gestation (ATSDR, 1994). Rats fed 150 to 300 ppm chlordane during and after gestation gave birth to normal offspring. If maintained with their birth mothers during lactation, the pups developed excitability and tremors, but when foster nursed to dams on control diets, the pups developed normally (Shepard, 1983). Defects in macrophage function at 100 days of age (Theus et al., 1991) and cell mediated immunity (Shepard, 1983) have been demonstrated in offspring of mice treated with 8 mg/kg during gestation. Significant depression of the numbers of fetal liver granulocyte-macrophage colony-forming units and spleen colony-forming units has been demonstrated in fetuses from mice treated with 8 mg/kg throughout gestation (Barnett et al., 1990). Cranmer et al. (1984) treated mice with 0.16 or 8 mg/kg/day throughout gestation and monitored corticosterone levels in the offspring. At birth there was no difference in the numbers of viable offspring, but during the first week 55% of the offspring born to dams receiving 8 mg/kg

died. At 400 days of age, male offspring exposed in utero to both levels of chlordane and high dose female offspring, had elevated corticosterone levels; these differences were resolved by 800 days of age.

### **3.1.5. Reference Dose**

#### **3.1.5.1. Subchronic**

ORAL RfD:	6E-5 mg/kg/day (U.S. EPA, 1994b)
NOAEL:	0.055 mg/kg/day
UNCERTAINTY FACTOR:	1000
PRINCIPAL STUDY:	Velsicol Chemical Co., 1983

COMMENTS: The chronic oral RfD was adopted as the subchronic oral RfD (U.S. EPA, 1994b).

#### **3.1.5.2. Chronic**

ORAL RfD:	6E-5 mg/kg/day (U.S. EPA, 1994a)
NOAEL:	0.055 mg/kg/day
LEL:	0.273 mg/kg/day
UNCERTAINTY FACTOR:	1000
CONFIDENCE:	
Study:	Medium
Data Base:	Low
RfD:	Low

VERIFICATION DATE:	3/22/89
PRINCIPAL STUDY:	Velsicol Chemical Co., 1983

COMMENTS: The RfD is based on the results of a 30-month chronic feeding study in rats. The critical effect was regional liver hypertrophy in females. An uncertainty factor of 100 was used to account for inter- and intraspecies variability. An additional factor of 10 was used to account for the lack of a reproduction study and a chronic study in another mammalian species, and the generally inadequate sensitive endpoints studied in existing studies, particularly since chlordane is known to bioaccumulate (U.S. EPA, 1994a).

## **3.2. INHALATION EXPOSURES**

### **3.2.1. Acute Toxicity**

#### **3.2.1.1. Human**

Gastrointestinal disorders and neurological symptoms were reported in workers within 4 days of an accidental spill of 1% chlordane. Exposure was from inhalation and/or dermal contact with most affected individuals being involved in the cleanup (ATSDR, 1994).

#### **3.2.1.2. Animal**

Death occurred in all rats exposed for 8 hours/day to either 413 mg/m<sup>3</sup> for 2 days or to 154 mg/m<sup>3</sup> for 5 days (ATSDR, 1994). Animals had evidence of respiratory tract and liver damage.

### **3.2.2. Subchronic Toxicity**

#### **3.2.2.1. Human**

Information on the subchronic toxicity of chlordane to humans by inhalation was not available.

#### **3.2.2.2. Animal**

Rats and monkeys were exposed to chlordane by inhalation at concentrations of 0.1, 1, and 10 mg/m<sup>3</sup> 8 hours/day, 5 days/week for 90 days (IARC, 1991). While no effects were seen in monkeys at any dose, mice had liver enlargement at the highest dose. Increased liver weights were found in female rats (5.8 mg/m<sup>3</sup>), increased liver and kidney weights occurred in male rats (28.2 mg/m<sup>3</sup>), serum chemistry changes indicative of liver damage and hypersensitivity occurred in females (28.2 mg/m<sup>3</sup>), and centrilobular hepatocyte enlargement occurred in males and females (28.2 mg/m<sup>3</sup>) exposed to chlordane by inhalation 8 hours/day, 5 days/week, for 28 days (ATSDR, 1994).

### **3.2.3. Chronic Toxicity**

#### **3.2.3.1. Human**

No increase in mortality rate has been found for workers employed in the manufacture or use of chlordane (ATSDR, 1994; Shindell and Ulrich, 1986). An epidemiological study on the health status of individuals whose homes had been treated with chlordane 1-24 years ago showed a positive correlation between indoor air levels (<1 µg/m<sup>3</sup>, 1-5 µg/m<sup>3</sup>, or >5 µg/m<sup>3</sup>) and the incidence of sinusitis, bronchitis, dermatitis, neuritis, and migraine (Menconi et al., 1988). Another survey reported headache, gastrointestinal distress, fatigue, memory deficits, personality changes, decreased attention span, numbness or paresthesias, disorientation, loss of coordination, dry eyes, and seizures from chlordane exposure in the home (indoor air levels were not measured) (Spyker et al., 1990). Blood dyscrasias, including production defects and thrombocytopenic purpura, have been described for professional applicators and for home owners and their families following home termite treatment with chlordane and heptachlor (Epstein and Ozonoff, 1987).

#### **3.2.3.2. Animal**

Information on the chronic inhalation toxicity of chlordane to animals was not available.

### **3.2.4. Developmental and Reproductive Toxicity**

#### **3.2.4.1. Human**

The incidence of ovarian and uterine disease was significantly elevated in women in chlordane-treated homes (Menconi et al., 1988).

#### **3.2.4.2. Animal**

No histopathological abnormalities were observed in the reproductive organs of rats exposed to 28.2 mg/m<sup>3</sup> for 28 days or in rats or monkeys exposed for 90 days to 10 mg/m<sup>3</sup>, 8 hours/day, 5 days/week (ATSDR, 1994).

### **3.2.5. Reference Concentration**

#### **3.2.5.1 Subchronic**

Contact the Superfund Health Risk Technical Support Center, (513) 569-7300, concerning the subchronic inhalation RfC for chlordane (U.S. EPA, 1994b).

#### **3.2.5.2 Chronic**

A risk assessment for chlordane is under review by an EPA working group (U.S. EPA 1994a).

### **3.3. OTHER ROUTES OF EXPOSURE**

#### **3.3.1. Acute Toxicity**

##### **3.3.1.1. Humans**

Dermal application of about 30 g of chlordane to an adult resulted in death within 40 minutes (ACGIH, 1991). Gastrointestinal disorders and neurological symptoms were reported in workers within 4 days of an accidental spill of 1% chlordane. Exposure was from inhalation and/or dermal contact with most affected individuals being involved in the cleanup (ATSDR, 1994).

##### **3.3.1.2. Animals**

The dermal LD<sub>50</sub> of chlordane in rabbits is 1100 - 1200 mg/kg (WHO, 1984). Rats injected intraperitoneally with 50 mg/kg once a day for 4 days had increased liver weights and increased lipid content of the liver (Ogata and Izushi, 1991). Gerbils injected intramuscularly with 2.5 mg/kg had hyperproteinemia, hyperglycemia, and increased serum alkaline and acid phosphatase activity (WHO, 1984).

#### **3.3.2. Subchronic Toxicity**

Information on the subchronic toxicity of chlordane to humans or animals by other routes of exposure was not available.

#### **3.3.3. Chronic Toxicity**

##### **3.3.3.1 Human**

Serum triglycerides, creatine phosphokinase, and lactic acid dehydrogenase activities were shown to be higher in pesticide applicators who wore masks. This would suggest that the effects were from dermal exposure, but the biological significance is unknown (Ogata and Izushi, 1991).

##### **3.3.3.2 Animal**

Information on the chronic toxicity of chlordane to animals by other routes of exposure was not available.

#### **3.3.4. Developmental and Reproductive Toxicity**

Information on the developmental and reproductive toxicity of chlordane to humans or animals by other routes of exposure was not available.



### **3.4. TARGET ORGANS/CRITICAL EFFECTS**

#### **3.4.1. Oral Exposures**

##### **3.4.1.1. Primary Target Organs**

1. Liver: In a 24-month feeding study with mice, hepatocellular swelling and necrosis occurred in males and increased liver weights occurred in males and females fed 5 ppm. Dogs fed chlordane at 0.3, 3, 15, or 30 mg/kg for 2 years had abnormal clinical liver function tests (not defined) at the two highest concentrations and a dose-related increase in liver weight.
2. CNS: Accidental poisonings by chlordane in humans has caused convulsions, agitation and restlessness, loss of coordination, and tachycardia. Death has been attributed to respiratory failure. Also, tremors developed in rat pups nursing from dams treated with 150-300 ppm in the diet.

##### **3.4.1.2. Other Target Organs**

Gastrointestinal disorders have been reported in humans after accidental poisoning with chlordane. Following prenatal exposure to chlordane, rats have shown altered endocrine and immune functions.

#### **3.4.2. Inhalation Exposures**

##### **3.4.2.1. Primary Target Organs**

1. Liver: Increased liver weights were found in female (5.8 mg/m<sup>3</sup>) and in male (28.2 mg/m<sup>3</sup>) rats, serum chemistry changes indicative of liver damage and hypersensitivity occurred in females (28.2 mg/m<sup>3</sup>), and centrilobular hepatocyte enlargement occurred in males and females (28.2 mg/m<sup>3</sup>) exposed to chlordane by inhalation 8 hours/day, 5 days/week, for 28 days.
2. CNS: Headache, fatigue, memory deficits, personality changes, decreased attention span, numbness or paresthesias, disorientation, loss of coordination, and seizures have been described from chlordane exposure in the home.

##### **3.4.2.2. Other Target Organs**

Gastrointestinal distress, dermatitis, sinusitis, and bronchitis have been associated with inhalation exposure to chlordane in treated homes.

#### **3.4.3. Other Routes of Exposure**

##### **3.4.3.1. Primary Target Organs**

1. Liver: Serum triglycerides, creatine phosphokinase, and lactic acid dehydrogenase activities were shown to be higher in pesticide applicators who wore masks suggesting that the effects were from dermal exposure to chlordane.
2. CNS: Neurological symptoms were reported in workers within 4 days of an accidental spill of 1% chlordane in which exposure was a combination of dermal and inhalation.

### **3.4.3.2. Other Target Organs**

Gastrointestinal distress occurred in workers from a combination of dermal and inhalation chlordane exposure.

## **4. CARCINOGENICITY**

### **4.1. ORAL EXPOSURES**

#### **4.1.1. Human**

Information on the carcinogenicity of chlordane to humans following oral exposure was not available.

#### **4.1.2. Animal**

Hepatic carcinomas and hepatocellular adenomas have been described for several strains of male and female mice and in one strain of male rat given chlordane in the diet. Male and female B6C3F1 mice were fed chlordane in the diet for 80 weeks; males received 29.9 or 56.2 ppm and females received 30.1 or 63.8 ppm (NCI, 1977). A dose-related increase (statistical significance,  $p < 0.001$ ) in hepatocellular carcinomas was observed in both sexes in both treated male groups and high-dose females. No tumors were reported for male or female Osborne-Mendel rats fed 203.5 or 407.0 ppm and 120.8 or 241.5 ppm, respectively (NCI, 1977). In an unpublished report by the International Research and Development Corporation under contract to Velsicol Chemical Corporation, male and female CD-1 mice were fed chlordane at concentrations of 0, 5, 25, or 50 ppm for 18 months (Howard and Epstein, 1976; U.S. EPA, 1994a). The original report described a dose-related increase in liver nodular hyperplasia at the two highest doses. However, histological reanalysis by several pathologists diagnosed the lesions as hepatocarcinomas. Male and female ICR mice were fed chlordane in the diet at doses of 0, 1, 5, or 12.5 mg/kg for 104 weeks (IARC, 1991). High-dose males had a significant increase in hepatocellular adenomas often with associated hemangiomas. A significant increase in liver adenomas was observed in male F344 rats, but not females, given 25 ppm chlordane in the diet for 130 weeks (U.S. EPA, 1994a).

### **4.2. INHALATION EXPOSURES**

#### **4.2.1. Human**

Information on the carcinogenicity of chlordane by inhalation in humans comes from case reports and epidemiology studies. Mortality due to cancer was found to be lower in workers employed in the manufacture of chlordane (Shindell and Ulrich, 1986; Brown, 1992). Fewer lung cancers were found in termite control operators (who are more likely to be exposed to chlordane) than in other pesticide control operators (MacMahon et al., 1988); but, in another study, an increase in respiratory cancers was associated with chlordane exposure (Brown, 1992). Exposure from treated homes has been associated with leukemia (Epstein and Ozonoff, 1987), skin neoplasms (Menconi et al., 1988), and neuroblastoma in children (IARC, 1991). An increased risk of non-Hodgkin's lymphoma has been found among farmers exposed to chlordane 20 or more days per year (Hoar Zahm et al., 1988).

#### **4.2.1. Animal**

Information on the carcinogenicity of chlordane by inhalation exposure to animals was not available.

### 4.3. OTHER ROUTES OF EXPOSURE

#### 4.3.1. Human

Information on the carcinogenicity of chlordane in humans by other routes of exposure was not available.

#### 4.3.2. Animal

Chlordane (2  $\mu$ M), applied 3 times weekly for 20 weeks, failed to promote tumors in DMBA-initiated mouse skin (Moser et al., 1993).

### 4.4 EPA WEIGHT-OF-EVIDENCE

#### 4.4.1. Oral

Classification: Group B2 -- Probable Human Carcinogen (U.S. EPA 1994a)

Basis: Benign and malignant liver tumor induction in 4 strains of male and female mice and in male rats treated with chlordane in the diet; structurally related to other liver carcinogens (U.S. EPA 1994a).

#### 4.4.2. Inhalation

Classification: Group B2 -- Probable Human Carcinogen (U.S. EPA 1994a)

Basis: Benign and malignant liver tumor induction in 4 strains of male and female mice and in male rats treated with chlordane in the diet; structurally related to other liver carcinogens (U.S. EPA 1994a).

### 4.5. CARCINOGENICITY SLOPE FACTORS

#### 4.5.1. Oral

SLOPE FACTOR:	$1.3\text{E}+0 \text{ (mg/kg/day)}^{-1}$ (U.S. EPA, 1994a)
DRINKING WATER UNIT RISK:	$3.7\text{E}-5 \text{ (}\mu\text{g/L)}^{-1}$ (U.S. EPA, 1994a)
VERIFICATION DATE:	4/1/87
PRINCIPAL STUDIES:	Velsicol Chemical Co., 1973; NCI, 1977

COMMENTS: Based on an increase in hepatocellular carcinomas in mice and hepatocellular adenomas in rats treated with chlordane in the diet (U.S. EPA, 1994a).

#### 4.5.2. Inhalation

SLOPE FACTOR:	$1.3\text{E}+0 \text{ (mg/kg/day)}^{-1}$ (U.S. EPA, 1994b)
INHALATION UNIT RISK:	$3.7\text{E}-4 \text{ (}\mu\text{g/m}^3\text{)}^{-1}$ (U.S. EPA, 1994a)
VERIFICATION DATE:	4/1/87
PRINCIPAL STUDIES:	Velsicol Chemical Co., 1973; NCI, 1977

COMMENTS: The inhalation risk estimates were calculated from the oral data (U.S. EPA, 1994a).

## 5. REFERENCES

- ACGIH (American Conference of Governmental Industrial Hygienists). 1991. Chlordane. Documentation of the Threshold Limit Values and Biological Exposure Indices, 6th ed. ACGIH, Inc., Cincinnati, OH, pp. 244- 246.
- Al-Omar, M.A., F.H. Abdul-Jalil, N.H. Al-Ogaily, S.J. Tawfiq, and M.A. Al-Bassomy. 1986. A follow-up study of maternal milk contamination with organochlorine insecticide residues. *Environ. Pollut. Ser. A* 42:79-91.
- ATSDR (Agency for Toxic Substances and Disease Registry) 1994. Toxicological Profile for Chlordane (Update). Prepared by Clement International Corporation, under Contract No. 205-88-0608 for ATSDR, Public Health Service, U.S. Department of Health and Human Services.
- Barnett, J.B., B.L. Blaylock, J. Gandy, J.H. Menna, R. Denton, and L.S.F. Soderberg. 1990. Alteration of fetal liver colony formation by prenatal chlordane exposure. *Fundam. Appl. Toxicol.* 15:820-822.
- Brown, D.P. 1992. Mortality of workers employed at organochlorine pesticide manufacturing plants - an update. *Scand. J. Work Environ. Health* 18:155-161.
- Budavari, S., M.J. O'Neil, A. Smith, and P.E. Heckelman, Eds. 1989. The Merck Index, 11 ed. Merck and Co., Rahway, NJ. p.321.
- Cranmer, J.M., M.F. Cranmer, and P.T. Goad. 1984. Prenatal chlordane exposure: effects on plasma corticosterone concentrations over the lifespan of mice. *Environ. Res.* 35:204-210.
- Dearth, M.A. and R.A. Hites. 1991. Chlordane accumulation in people. *Environ. Sci. Technol.* 25:1279-1285.
- Epstein, S.S. and D. Ozonoff. 1987. Leukemias and blood dyscrasias following exposure to chlordane and heptachlor. *Teratog. Carcinog. Mutag.* 7:527-540.
- Ewing, A.D., A.M. Kadry, and H.W. Dorough. 1985. Comparative disposition and elimination of chlordane in rats and mice. *Tox. Lett.* 26:233-239.
- Giroux, D., G. Lapointe, and M. Baril. 1992. Toxicological index and the presence in the workplace of chemical hazards for workers who breast-feed infants. *Am. Ind. Hyg. Assoc. J.* 53:471-474.
- Hoar Zahm, S., D.D. Weisenburger, P.A. Babbitt, R.C. Saal, K.P. Cantor, and A. Blair. 1988. A case-control study of non-Hodgkin's lymphoma and agricultural factors in eastern Nebraska. *Am. J. Epidemiol.* 128:901.
- Howard, J.H. and S.S. Epstein. 1976. Review of carcinogenicity tests on chlordane in mice. *Sci. Total Environ.* 6:103-154.
- IARC (International Agency for Research on Cancer). 1991. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Occupational exposures in insecticide application, and some pesticides. Vol. 53. IARC, Lyon, France, pp. 115-175.
- MacMahon, B., R.R. Monson, H.H. Wang, and T. Zheng. 1988. A second follow-up of mortality in a cohort of pesticide applicators. *J. Occup. Med.* 30:429-432.

Menconi, S., J.M. Clark, P. Langenberg, and D. Hryhorczuk. 1988. A preliminary study of potential human health effects in private residences following chlordane applications for termite control. *Arch. Environ. Health* 43:349-352.

Moser, G.J., C.L. Robinette, and R.C. Smart. 1993. Characterization of skin tumor promotion by mirex: structure-activity relationships, sexual dimorphism and presence of Ha-*ras* mutation. *Carcinogenesis* 14:1155-1160.

NCI (National Cancer Institute). 1977. Bioassay of Chlordane for Possible Carcinogenicity CAS No. 57-74-9. Technical Report Series No. 8.

Ogata, M. and F. Izushi. 1991. Effects of chlordane on parameters of liver and muscle toxicity in man and experimental animals. *Tox. Lett.* 56:327-337.

Saito, I., N. Kawamura, K. Uno, N. Hisanaga, Y. Takeuchi, Y. Ono, M. Iwata, M. Gotoh, H. Okutani, T. Matsumoto, Y. Fukaya, S. Yoshitomi, and Y. Ohno. 1986. Relationship between chlordane and its metabolites in blood of pest control operators and spraying conditions. *Int. Arch. Occup. Environ. Health* 58:91-97.

Shepard, T.H. (Ed.). 1983. *Catalog of Teratogenic Agents*, 4th ed. The Johns Hopkins University Press, Baltimore, MD. p. 85.

Shindell, S. and S. Ulrich. 1986. Mortality of workers employed in the manufacture of chlordane: an update. *J. Occup. Med.* 28:497-501.

Spyker, D.A., R.R. Bond, M. Jylkka, and P.G. Bernard. 1990. Subacute home chlordane poisoning: fact or fallacy. *Ann. Emerg. Med.* 19:628.

Theus, S., D. Tabor, and J. Barnett. 1991. Alteration of macrophage TNF production by prenatal chlordane exposure. *FASEB J.* 5:A1347.

U.S. EPA (U.S. Environmental Protection Agency). 1994a. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH.

U.S. EPA (U.S. Environmental Protection Agency). 1994b. Health Effects Assessment Summary Tables. Annual FY-94. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Emergency and Remedial Response, Washington, DC.

Velsicol Chemical Co. 1973. MRID No. 00067568. (Cited in U.S. EPA, 1994a).

Velsicol Chemical Co. 1983. MRID No. 00144312. (Cited in U.S. EPA, 1994a).

WHO (World Health Organization). 1984. *Environmental Health Criteria Vol. 34. Chlordane*. WHO, Geneva, Switzerland. 82 pp.

**TOXICITY SUMMARY FOR  
CHLOROFORM**

DECEMBER 1992

Prepared by

Rosmarie A. Faust, Ph.D.  
Chemical Hazard Evaluation and Communication Group  
Biomedical and Environmental Information Analysis Section  
Health and Safety Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for

U.S. ARMY TOXIC AND  
HAZARDOUS MATERIALS AGENCY  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Environmental Branch, Technology Division  
U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY  
Aberdeen Proving Ground, Maryland 210-5401

---

\*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under  
Contract No. DE-AC05-84OR21400

## EXECUTIVE SUMMARY

Chloroform is a colorless, volatile liquid that is widely used as a general solvent and as an intermediate in the production of refrigerants, plastics, and pharmaceuticals (Torkelson and Rowe, 1976; IARC, 1976). Chloroform is rapidly absorbed from the lungs and the gastrointestinal tract, and to some extent through the skin. It is extensively metabolized in the body, with carbon dioxide as the major end product. The primary sites of metabolism are the liver and kidneys. Excretion of chloroform occurs primarily via the lungs, either as unchanged chloroform or as carbon dioxide (ATSDR, 1989).

Target organs for chloroform toxicity are the liver, kidneys, and central nervous system. Liver effects (hepatomegaly, fatty liver, and hepatitis) were observed in individuals occupationally exposed to chloroform (Bomski et al., 1967). Several subchronic and chronic studies by the oral or inhalation routes of exposure documented hepatotoxic effects in rats, mice, and dogs (Palmer et al., 1979; Munson et al., 1979; Heywood et al., 1979). Renal effects were reported in rats and mice following oral and inhalation exposures (Roe et al., 1979; Reuber, 1976; Torkelson et al., 1976), but evidence for chloroform-induced renal toxicity in humans is sparse. Chloroform is a central nervous system depressant, inducing narcosis and anesthesia at high concentrations. Lower concentrations may cause irritability, lassitude, depression, gastrointestinal symptoms, and frequent and burning urination (ATSDR, 1989).

Developmental toxicity studies with rodents indicate that inhaled and orally administered chloroform is toxic to dams and fetuses. Possible teratogenic effects were reported in rats and mice exposed to chloroform by inhalation (Schwetz et al., 1974; Murray et al., 1979). Chloroform may cause sperm abnormalities in mice and gonadal atrophy in rats (Palmer et al., 1979; Reuber, 1979; Land et al., 1981).

A Reference Dose (RfD) of 0.01 mg/kg/day for subchronic and chronic oral exposure was calculated from a lowest-observed-adverse-effect level (LOAEL) of 15 mg/kg/day based on fatty cyst formation in the liver of dogs exposed to chloroform for 7.5 years (Heywood et al., 1979). Development of an inhalation Reference Concentration (RfC) is presently under review (U.S. EPA, 1992b).

Epidemiological studies indicate a possible relationship between exposure to chloroform present in chlorinated drinking water and cancer of the bladder, large intestine, and rectum. Chloroform is one of several contaminants present in drinking water, but it has not been identified as the sole or primary cause of the excess cancer rate (ATSDR, 1989; U.S. EPA, 1985). In animal carcinogenicity studies, positive results included increased incidences of renal epithelial tumors in male rats, hepatocellular carcinomas in male and female mice, and kidney tumors in male mice (Jorgensen et al., 1985; Roe et al., 1979; NCI, 1976).

Based on U.S. EPA guidelines, chloroform was assigned to weight-of-evidence Group B2, probable human carcinogen, on the basis of an increased incidence of several tumor types in rats and in three strains of mice. The carcinogen slope factor ( $q_1^*$ ) for chloroform is  $6.1\text{E-}3$  (mg/kg/day) $^{-1}$  for oral exposure (U.S. EPA, 1992b) and  $8.1\text{E-}2$  ( $\mu\text{g}/\text{m}^3$ ) $^{-1}$  for inhalation exposure (U.S. EPA, 1992a). An inhalation unit risk of  $2.3\text{E-}5$  ( $\mu\text{g}/\text{m}^3$ ) $^{-1}$  is based on hepatocellular carcinomas in mice in an oral gavage study (U.S. EPA, 1992b).

## 1. INTRODUCTION

Chloroform ( $\text{CHCl}_3$ ; CAS No. 67-66-3), also known as trichloromethane, is a colorless, volatile liquid with a pleasant ethereal odor (DeShon, 1979; IARC, 1979). It has a molecular weight of 119.38, a density of  $1.485 \text{ g/cm}^3$  at  $20^\circ\text{C}$  (Hawley, 1981), and an octanol/water partition coefficient of 1.97 (Hansch and Leo, 1985). It is only slightly soluble in water, but is miscible with alcohol, benzene, ether, petroleum ether, carbon tetrachloride, carbon disulfide, and oils (Budavari et al., 1989). Chloroform is widely used as an intermediate in the production of refrigerants, plastics, and pharmaceuticals, and as a general solvent or constituent of solvent mixtures (Torkelson and Rowe, 1981; IARC, 1979). In the past, chloroform has been extensively used as a surgical anesthetic, but this use was discontinued because exposure to narcotic concentrations resulted in adverse side effects. The Food and Drug Administration has banned the use of chloroform as an ingredient in human drug and cosmetic products as of July, 1976 (U.S. FDA, 1976).

Human exposure to chloroform can occur orally, dermally, or by inhalation. Chloroform is the principal trihalomethane generated as by-products during the chlorination of drinking water. The primary sources of chloroform in the environment are chlorinated drinking water and wastewater, pulp and paper mills, and chemical and pharmaceutical manufacturing plants. Most of the chloroform released to the environment eventually enters the atmosphere, while much smaller amounts enter groundwater as a result of filtration through the soil (ATSDR, 1989).

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

Chloroform is rapidly absorbed through the lungs and the gastrointestinal tract, and to some extent through the skin (Torkelson and Rowe, 1981). In humans, the respiratory absorption of chloroform ranges from 49 to 77% (ATSDR, 1989) and absorption from the gastrointestinal tract approximates 100%, with peak blood levels being reached within 1 hour (Fry et al., 1972). Essentially complete oral absorption has also been reported in rats, mice, and monkeys (Brown et al., 1974; Taylor et al., 1974).

### 2.2. DISTRIBUTION

Following its absorption, chloroform is distributed to all organs (IARC, 1979). Humans exposed to chloroform by inhalation exhibited a three-component decrease of blood chloroform levels, with a rapid phase having a half-life of 14 min, a slower phase with a half-life of 90 min, and a very slow phase with an undetermined half-life (Fry et al., 1972). A number of studies have shown that chloroform accumulates in the body fat of humans and animals. It is lipid soluble, readily passes through cell membranes, reaching relatively high concentrations in nervous tissue. Chloroform concentrations in tissues are dose-related and occur in the following order: adipose > brain > liver > kidney > blood (ATSDR, 1989). Chloroform passes through the placenta and has been detected in fetal blood at levels equal to or greater than those in maternal blood (Dowty et al., 1976).

### 2.3. METABOLISM

Chloroform is metabolized by oxidative dehydrochlorination of its carbon-hydrogen bond to form phosgene ( $\text{CCl}_2\text{O}$ ). The reaction is P450-mediated and occurs in both the liver and the kidney. The major end product of chloroform metabolism is carbon dioxide ( $\text{CO}_2$ ), most of which is eliminated via the lungs, but some is incorporated into endogenous metabolites and may be excreted as bicarbonate, urea, methionine and other amino acids, inorganic chloride ion, and carbon monoxide (ATSDR, 1989).



## 2.4. EXCRETION

Fry et al. (1972) studied a group of volunteers who ingested 500 mg of  $^{14}\text{C}$ -labelled chloroform. More than 96% of the administered isotope was exhaled within 8 hours, 18-67% of which was excreted unchanged by this route; less than 1% appeared in urine. Lean subjects eliminated a greater percentage of the dose via the lungs than overweight subjects. The fraction reported metabolized to  $\text{CO}_2$  was 46% for a male and 58% for a female (Fry et al., 1972; Chiou, 1975). Rats, mice, and monkeys excreted 6, 20, and 78%, respectively, of an oral 60-mg/kg dose as unchanged parent compound in air (Torkelson and Rowe, 1981).

## 3. NONCARCINOGENIC HEALTH EFFECTS

### 3.1. ORAL EXPOSURES

#### 3.1.1. Acute Toxicity

##### 3.1.1.1. Human

Chloroform is acutely toxic to the liver although damage may not be fully apparent until 12-48 hours after exposure. Liver effects include centrilobular necrosis and reduced prothrombin formation (ATSDR, 1989). Schroeder (1965) reported that a fatal oral dose of chloroform may be as little as 10 mL (14.8 g), with death due to respiratory or cardiac arrest. Gosselin et al. (1984) estimate that the mean lethal oral dose is 44 g for humans.

##### 3.1.1.2. Animal

Oral  $\text{LD}_{50}$  values range from 444 to 2000 mg/kg for rats and from 118 to 1400 mg/kg for mice (U.S. Air Force, 1989). Torkelson et al. (1976) reported that 250 mg/kg of orally administered chloroform produced fatty infiltration and necrosis of the liver as well as kidney damage in rats. Liver and kidney damage was also reported in CD-1 mice treated daily for 14 days with 148 mg/kg chloroform in corn oil by gavage (Condie et al., 1983).

#### 3.1.2. Subchronic Toxicity

##### 3.1.2.1. Human

The long-term use of a dentrifice containing 3-4% chloroform and a mouthwash containing 0.43% chloroform was investigated in a study involving 299 subjects (DeSalva et al., 1975). Ingestion was estimated to be 0.3-0.96 mg/kg/day over a 1- to 5-year period. There were no statistical differences between experimental and control subjects in any of the parameters [alanine aminotransferase (ALT), aspartate aminotransferase (AST), and blood urea nitrogen] monitored as tests for liver and kidney function.

##### 3.1.2.2. Animal

Chu et al. (1982) exposed Sprague-Dawley rats to 5, 50, 500, or 2500 ppm chloroform in drinking water for 90 days. Increased mortality, decreased growth rate, and decreased food intake were reported at the highest dose. Histological examination of treated animals showed mild to moderate fatty infiltration of the liver and reduction in follicular size and colloid density of the thyroid. These lesions were not significantly different from controls, with the exception of thyroid effects observed in the highest-dosed males.

Chloroform administered by gavage in toothpaste at a dose of 15, 30, 150, or 410 mg/kg/day, 6 days/week for 13 weeks to Sprague-Dawley rats produced increased liver weight and fatty changes with

necrosis in the high-dose group. Increased liver weights were seen at 150 mg/kg/day, but no effects were seen at the lower doses (Palmer et al., 1979).

Munson et al. (1982) administered 0, 50, 125, or 250 mg/kg/day chloroform by gavage to male and female CD-1 mice for 90 days. Chloroform-treated male and female mice exhibited increased liver weights and slight histologic changes in liver and kidneys.

Liver effects were also observed in beagle dogs administered chloroform in gelatin capsules at doses ranging from 30 to 120 mg/kg/day for up to 18 weeks (Heywood et al., 1979). At  $\geq 60$  mg/kg/day, hepatocyte enlargement with vacuolization, fatty deposits of the liver, and increased ALT, AST, and serum alkaline phosphatase (SAP) activity were observed.

### **3.1.3. Chronic Toxicity**

#### **3.1.3.1. Human**

Hepatitis and kidney nephrosis were reported in a patient who had ingested a chloroform-containing cough-suppressant over a ten-year period. Chloroform intake was estimated at 1.6-2.6 g/day (Wallace, 1950). Although the investigator attributed the effects to chloroform, the patient had ingested moderate amounts of alcohol daily, a known liver toxicant, until about a year prior to the examination.

#### **3.1.3.2. Animal**

Palmer et al. (1979) administered 3.5% chloroform in toothpaste by gavage for 80 weeks to male and female Sprague-Dawley rats. Retardation in weight gain and decreases in relative liver weights were observed in female rats. Decreased plasma cholinesterase activity was observed in both sexes.

Reuber (1979) re-examined histological sections from an NCI (1976) carcinogenesis bioassay in which rats received 90 mg/kg/day chloroform by gavage for 78 weeks. Interstitial fibrosis of the kidneys, polyarteritis of the mesenteric, pancreatic, and other arteries, and testicular atrophy were observed in rats receiving this dose.

Roe et al. (1979) administered chloroform in toothpaste, by gavage, to mice at doses of 0, 17, or 60 mg/kg/day, 6 days/week for 80 weeks, followed by 16-24 weeks of observation. There was an increased incidence of moderate to severe renal disease and benign and malignant tumors in the group treated with 60 mg/kg/day. No adverse effects occurred in the lower-dose group.

Male and female beagle dogs were fed capsules containing 0, 15, or 30 mg/kg/day chloroform in a toothpaste base, 6 days/week for 7.5 years, followed by 20 to 24 weeks of observation (Heywood et al., 1979). Fatty cysts were found in the liver of all groups; however, they were larger and more numerous in chloroform-treated dogs. There was also a moderate dose-related increase in serum ALT activity and other serum enzymes, indicative of liver damage.

### **3.1.4. Developmental and Reproductive Toxicity**

#### **3.1.4.1. Human**

Information on the developmental and reproductive toxicity of chloroform following oral exposure in humans was unavailable.

### 3.1.4.2. Animal

Thompson et al. (1974) orally administered chloroform to rats (20, 50, or 126 mg/kg/day) and rabbits (20, 35, or 50 mg/kg/day) on gestation days 6-15 and 6-18, respectively. In rats, no adverse effects occurred at 20 mg/kg/day, but maternal toxicity, characterized by decreased body weight gain and mild fatty change in the liver, was evident at  $\geq 50$  mg/kg. Fetal body weights were significantly decreased at 126 mg/kg/day. In rabbits, maternal weight gain was decreased at 50 mg/kg, and mean fetal body weight was decreased at 20 and 50 mg/kg/day, but not at 35 mg/kg/day.

Testicular atrophy was one of the effects observed in SD rats administered chloroform at a dose of 410 mg/kg/day by gavage for 13 weeks (Palmer et al., 1979) and in Osborne-Mendel rats administered 90 mg/kg/day by gavage for 78 weeks (Reuber, 1979).

### 3.1.5. Reference Dose

#### 3.1.5.1. Subchronic

ORAL RfD:	0.01 mg/kg/day (U.S. EPA, 1992a,b)
UNCERTAINTY FACTOR:	1000
LOAEL:	15 mg/kg/day

COMMENT: The same study applies to the subchronic and chronic RfD.  
The study is described in Section 3.1.3.2.

#### 3.1.5.1. Chronic

ORAL RfD:	0.01 mg/kg/day (U.S. EPA, 1992a,b)
UNCERTAINTY FACTOR:	1000
LOAEL:	15 mg/kg/day

CONFIDENCE:

Study	Medium
Data Base	Medium
RfD	Medium

VERIFICATION DATE: 12/02/85

PRINCIPAL STUDY: Heywood et al., 1979

COMMENTS: The LOAEL was based on the formation of fatty cysts in the liver of dogs. The uncertainty factor of 1000 includes a factor of 10 for interspecies extrapolation, 10 for protection of sensitive human subpopulations, and 10 for extrapolation from LOAEL to NOAEL (U.S. EPA, 1992b).

### 3.2. INHALATION EXPOSURES

#### 3.2.1. Acute Toxicity

##### 3.2.1.1. Human

Chloroform is a central nervous system (CNS) depressant. Concentrations of 20,000 to 40,000 ppm were formerly used to induce anesthesia with lower concentrations used to maintain it. Delayed toxic effects observed after use as an anesthetic included drowsiness, restlessness, vomiting, fever, elevated pulse rate, jaundice, liver enlargement, abdominal tenderness, abnormal liver and kidney function, delirium, and coma. Chloroform may sensitize the heart to epinephrine, causing arrhythmias (ATSDR, 1989). In experimental human exposures to chloroform vapors, approximately 14,000-16,000 ppm caused narcosis. Dizziness, intracranial pressure, and nausea resulted after a 7-minute exposure to 1000 ppm, with fatigue and headache as after effects. A 30-minute exposure to 390 ppm caused no adverse effects (Torkelson and Rowe, 1981).

##### 3.2.1.2. Animal

An inhalation  $LC_{50}$  of 10,000 ppm for rats exposed to chloroform for 4 hours was reported by Lundberg et al. (1986). Exposure to 2500 ppm for 2 hours caused no obvious CNS effects in mice; 3100 ppm for 1 hour induced slight narcosis; and 4000 ppm induced deep narcosis within 30 minutes. Cats exposed to 7200 ppm experienced disturbed equilibrium after 5 minutes and narcosis as exposure duration increased (U.S. EPA, 1985).

#### 3.2.2. Subchronic Toxicity

##### 3.2.2.1. Human

Nine of ten female individuals occupationally exposed for approximately 5 years to chloroform vapors at an average breathing zone concentration of 128 ppm experienced various symptoms, including irritability, lassitude, depression, gastrointestinal distress, and frequent and burning urination (Challen et al., 1958). Workers exposed to lower concentrations and shorter time periods experienced less severe symptoms. No evidence of liver injury was seen in either exposure group.

Workers at a pharmaceutical plant, where chloroform was used as the main solvent, were exposed to an estimated air concentration of 2-205 ppm of chloroform as well as to small amounts of other solvents (Bomski et al., 1967). Enlarged livers were seen in 17/68 workers exposed regularly to chloroform for 1-4 years and still in contact with chloroform; in 5/39 workers with past exposure to chloroform; in 2/23 with hepatitis but no exposure to chloroform (positive controls); and in 2/164 workers with no hepatitis and no

exposure to chloroform. Of the 17 workers still exposed who had enlarged livers, 4 had toxic hepatitis (based on increased alanine aminotransferase, aspartate aminotransferase, and serum gamma globulin levels) and 14 had fatty degeneration of the liver. Also reported was a high incidence of enlargement of the spleen as well as complaints of headache, nausea, eructation, and loss of appetite.

#### **3.2.2.2. Animal**

Torkelson et al. (1976) exposed rats, rabbits, and guinea pigs to 0, 25, 50, or 85 ppm chloroform vapor, 7 hours/day, 5 days/week for 6 months. Dogs (1/sex) were similarly exposed to 25 ppm. Increased relative kidney weights, cloudy swelling of the renal tubular epithelium, and lobular, granular degeneration with necrosis of the liver were seen in male rats at all three exposure concentrations. Also seen in male rats were decreased body weights at 50 and 85 ppm, and increased relative liver weights at 85 ppm. In female rats at 25 ppm, there was only an increase in relative kidney weights. At 50 and 85 ppm, liver and kidney pathology was similar to that seen in males. Experiments with rabbits and guinea pigs gave inconsistent results. Histological lesions were observed in the liver and kidneys of rabbits and guinea pigs at 25 ppm but not at 50 ppm in either species. At 85 ppm, histological lesions were observed in rabbits but not in guinea pigs. Histological changes in the kidneys were seen in the female but not the male dog at 25 ppm.

#### **3.2.3. Chronic Toxicity**

Information on the chronic inhalation toxicity of chloroform in humans or animals was unavailable.

#### **3.2.4. Developmental and Reproductive Toxicity**

##### **3.2.4.1. Human**

Information on the developmental and reproductive toxicity of chloroform following inhalation exposure in humans was unavailable.

##### **3.2.4.2. Animal**

Schwetz et al. (1974) exposed Sprague-Dawley rats to chloroform at concentrations of 0, 30, 100, or 300 ppm, 7 hours/day, on days 6-15 of gestation. Exposure to 30 ppm caused significantly increased incidences of fetal abnormalities, such as delayed skull ossification and wavy ribs compared with controls. At 100 ppm, there was a significantly increased incidence of missing ribs, short or missing tail, imperforate anus, subcutaneous edema, and delayed ossification of sternebrae. A decrease in pregnancy rate, number of live fetuses/litter, and an increased percentage of litters with absorptions was seen at 300 ppm. Subcutaneous edema and skull abnormalities were also observed, but their incidence was not statistically significant, possibly due to the small number of surviving fetuses. Decreased maternal weight gain occurred at all dose levels.

Murray et al. (1979) observed an increased incidence of cleft palate, decreased fetal body weight, and decreased crown to rump length in CF-1 mice exposed to 100 ppm on days 8-15 of gestation.

Male mice exposed to 0.04 or 0.08% (400 or 800 ppm) chloroform, 4 hours/day for 5 days exhibited a significant increase in the percentage of abnormal sperm (Land et al., 1981).

#### **3.2.5. Reference Concentration/Dose**

A subchronic or chronic reference concentration/dose for chloroform was not available at this time. However, a risk assessment for chloroform is under review by an EPA work group (U.S. EPA, 1992b).

### **3.3. OTHER ROUTES OF EXPOSURE**

#### **3.3.1. Acute Toxicity**

##### **3.3.1.1. Human**

Liquid chloroform in the eye causes tearing and conjunctivitis (Grant, 1974).

##### **3.3.1.2. Animal**

Dermal applications of 1000 mg/kg for 24 hours caused degenerative changes in kidney tubules of rabbits (Torkelson et al., 1976).

#### **3.3.2. Subchronic Toxicity**

Information on the subchronic toxicity of chloroform by other routes of exposure in humans or animals was unavailable.

#### **3.3.3. Chronic Toxicity**

Information on the chronic toxicity of chloroform by other routes of exposure in humans or animals was unavailable.

#### **3.3.4. Developmental and Reproductive Toxicity**

Information on the developmental and reproductive toxicity of chloroform by other routes of exposure in humans or animals was unavailable.

### **3.4. TARGET ORGANS/CRITICAL EFFECTS**

#### **3.4.1. Oral Exposures**

##### **3.4.1.1. Primary Target Organs**

1. Liver: Following oral exposure to chloroform, hepatic effects in experimental animals include increased liver weight, fatty degeneration with necrosis of the liver, and increased liver enzyme activity. Hepatotoxic effects were reported in a patient who had ingested a chloroform-containing cough remedy over a 10-year period.
2. Kidney: Oral exposure to chloroform caused interstitial fibrosis in rats and necrosis, fibrosis, tubular degeneration, and hyperplasia in mice. Nephrosis was reported in a patient who had ingested chloroform in a cough remedy over a 10-year period.
3. Testes: After oral exposure to chloroform, rats exhibited testicular atrophy.

##### **3.4.1.2. Other Target Organs**

1. Thyroid: Reduction of follicular size and colloid density of the thyroid was reported in one study with rats.
2. Vascular system: Polyarteritis of mesenteric, pancreatic, and other arteries was reported in one study with rats.

### **3.4.2. Inhalation Exposures**

#### **3.4.2.1. Primary Target Organs**

1. Liver: Following inhalation exposure to chloroform, hepatic effects in experimental animals included increased liver weights, lobular degeneration, and necrosis of the liver. Increased liver weights, fatty degeneration of the liver, and hepatitis were reported in individuals occupationally exposed to chloroform.
2. Kidney: Animals exposed to chloroform by inhalation developed increased kidney weights and cloudy swelling of the renal tubular epithelium.
3. Central nervous system: Symptoms in workers exposed to chloroform included headache, depression, irritability, and lassitude.
4. Gastrointestinal tract: Symptoms in workers exposed to chloroform included nausea, eructation, and lack of appetite.
5. Reproduction and development: After inhalation exposure to chloroform, reproductive effects in rats include decreased number of live fetuses/litter and increased resorptions. Also reported were missing ribs, short or missing tail, imperforate anus, subcutaneous edema, delayed ossification of sternebrae, and skull abnormalities. An increased incidence of cleft palate and abnormal sperm as well as decreased fetal body weight was seen in mice.

#### **3.4.2.2. Other Target Organs**

Enlargement of the spleen was reported in humans occupationally exposed to chloroform.

## **4. CARCINOGENICITY**

### **4.1. ORAL EXPOSURES**

#### **4.1.1. Human**

Several epidemiological and case control studies of populations consuming chlorinated drinking water, containing chloroform as well as numerous other contaminants, showed small but significant increases in the incidence of cancer of the large intestine, rectum, and/or bladder. However, chloroform was not identified as the sole or primary cause for excess cancer (ATSDR, 1989). According to U.S. EPA (1985), the human data suggest a possible increased risk of cancer at these three sites because chloroform is the predominant trihalomethane in drinking water, but the data are too weak to draw a conclusion about the carcinogenic potential of chloroform.

#### **4.1.2. Animal**

In a carcinogenesis bioassay (NCI, 1976), Osborne-Mendel rats and B6C3F<sub>1</sub> mice were treated by gavage with chloroform in corn oil 5 times/week for 78 weeks. Male rats received 90 or 125 mg/kg/day; females were treated initially with 125 or 250 mg/kg/day for 22 weeks, and then with 90 or 180 mg/kg/day thereafter. Male and female mice initially received 100 or 200 mg/kg/day and 200 or 400 mg/kg/day, respectively. These levels were increased after 18 weeks to 150 or 300 and 250 or 500 mg/kg/day, respectively. In male rats, there was a significant dose-related increase in the incidence of kidney epithelial tumors; in male and female mice, there was a significant dose-related increase of hepatocellular carcinomas.

Jorgensen et al. (1985) administered 0, 200, 400, 900, or 1800 ppm chloroform (pesticide quality and distilled) in drinking water to male Osborne-Mendel rats and female B6C3F<sub>1</sub> mice for 104 weeks. In male rats, there was a significant ( $p < 0.01$ ), dose-related increase in the incidence of renal tubular cell adenomas and/or adenocarcinomas that was slightly lower than that seen in the NCI (1976) study. However, in contrast to the NCI (1976) study, there was no increased incidence of hepatocellular tumors in female mice.

Roe et al. (1979) administered toothpaste containing chloroform (60 mg/kg/day, 6 days/week for 80 weeks, by gavage) to four strains of male mice. The incidence of kidney tumors was not increased in treated C57BL, CBA, or CF/1 mice. However, benign and malignant kidney tumors were seen in ICI mice.

According to IARC (1979), there is sufficient evidence that chloroform is carcinogenic in animals.

## 4.2. INHALATION EXPOSURES

Information on the carcinogenicity of chloroform following inhalation exposure in humans or animals was unavailable.

## 4.3. OTHER ROUTES OF EXPOSURE

U.S. EPA (1992b) reported negative results in pulmonary tumor bioassays in which two strains of mice were treated subcutaneously with chloroform.

## 4.4. EPA WEIGHT-OF-EVIDENCE

### 4.4.1. Oral

Classification -- B2; probable human carcinogen

Basis -- Increased incidence of several tumor types in rats and three strains of mice (U.S. EPA, 1992b)

### 4.4.2. Inhalation

Not assigned

## 4.5. Carcinogenicity Slope Factors

### 4.5.1. Oral

SLOPE FACTOR:	$6.1\text{E-}3 \text{ (mg/kg/day)}^{-1}$
DRINKING WATER UNIT RISK:	$1.7\text{E-}7 \text{ (}\mu\text{g/L)}^{-1}$
PRINCIPAL STUDY:	Jorgensen et al. (1985)
VERIFICATION DATE:	08/26/87 (U.S. EPA, 1992b)

### 4.5.2. Inhalation

SLOPE FACTOR:	$8.1\text{E-}2 \text{ (}\mu\text{g/m}^3\text{)}^{-1}$ (U.S. EPA, 1992a)
INHALATION UNIT RISK:	$2.3\text{E-}5 \text{ (}\mu\text{g/m}^3\text{)}^{-1}$ (U.S. EPA, 1992b)
VERIFICATION DATE:	08/26/87
PRINCIPAL STUDY:	NCI, 1976

COMMENT: The inhalation slope factor and unit risk were derived from an oral gavage study with mice (NCI, 1976).



## 5. REFERENCES

- ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for Chloroform. Prepared by Syracuse Research Corporation, under Contract 68-C8-0004. U.S. Public Health Service. ATSDR/TP-88/09.
- Bomski, H., A. Sobolweska and A. Strakowski. 1967. Toxic damage to the liver by chloroform in chemical industry workers. *Arch. Gewerbepathol. Gewerbehyg.* 24: 127-134. (In German; cited in ATSDR, 1989; Torkelson and Rowe, 1981; IARC, 1979)
- Brown, D.M., P.F. Langley, D. Smith, et al. 1974. Metabolism of Chloroform. I. The metabolism of [ $^{14}\text{C}$ ]-chloroform by different species. *Xenobiotica* 4: 151-163.
- Budavari, S., M.J. O'Neil and A. Smith (Eds). 1989. The Merck Index. Merck & Co., Inc., Rahway, NJ, p. 2137.
- Challen, P.J.R., D.E. Hickish and J. Bedford. 1958. Chronic chloroform intoxication. *Br. J. Ind. Med.* 15:243-249.
- Chiou, W.L. 1975. Quantitation of hepatic and pulmonary first-pass effects and its implication in pharmacokinetic study. I. Pharmacokinetics of chloroform in man. *J. Pharmacokinet. Biopharm.* 3:193-201. (Cited in ATSDR, 1989)
- Chu, I., D.C. Villeneuve, V.E. Secours, et al. 1982. Toxicity of trihalomethanes. II. Reversibility of toxicological changes produced by chloroform, bromodichloromethane, chlorodibromomethane and bromoform in rats. *J. Environ. Sci. Health B17*: 225-240.
- Condie, L.W., C.L. Smallwood and R.D. Laurie. 1983. Comparative renal and hepatotoxicity of halomethanes: Bromodichloromethane, bromoform, chloroform, dibromochloromethane, and methylene chloride. *Drug Chem. Toxicol.* 6: 564-578.
- DeSalva, S., A. Volpe, G. Leigh, et al. 1975. Long-term safety studies of a chloroform-containing dentrifice and mouth-rinse in man. *Food Cosmet. Toxicol.* 13: 529-532.
- Deshon, H.D. 1979. Chloroform. In: Grayson, M. and D. Eckroth, Eds. *Kirk-Othmer Encyclopedia of Chemical Technology*, 3rd. ed., Vol. 5. John Wiley & Sons, New York, pp. 693-703.
- Dowty, B.J., J.L. Laseter and J. Storer. 1976. Transplacental migration and accumulation in blood of volatile organic constituents. *Pediatr. Res.* 10: 696-375.
- Fry, B.J., T. Taylor and D.E. Hathway. 1972. Pulmonary elimination of chloroform and its metabolites in man. *Arch. Int. Pharmacodyn.* 196: 98-111.
- Gosselin, R.E., R.P. Smith, H.C. Hodge, et al. 1984. *Clinical Toxicology of Commercial Products. Acute Poisoning*, 5th ed. Williams and Wilkins, Baltimore, MD, p. II-161.
- Grant, W.M. 1974. *Toxicology of the Eye*, 2nd ed. Charles C. Thomas Publisher, Springfield, IL, pp. 267-268.
- Hansch, C. and A.J. Leo. 1985. Medchem Project Issue 26. Pomona College, Claremont, CA. (Cited in ATSDR, 1989)

- Hawley, G.G. 1981. The Condensed Chemical Dictionary, 10th ed. Van Nostrand Reinhold, New York, NY, p. 237.
- Heywood, R., R.J. Sortwell, P.R.B. Noel, et al. 1979. Safety evaluation of toothpaste containing chloroform. III. Long-term study in beagle dogs. *J. Environ. Pathol. Toxicol.* 2: 835-851.
- IARC (International Agency for Research on Cancer). 1979. Chloroform. In: Some Halogenated Hydrocarbons. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Vol. 20. World Health Organization, Lyon, France, pp. 401-427.
- Jorgenson, T.A., E.F. Meierhenry, C.J. Rushbrook, et al. 1985. Carcinogenicity of chloroform in drinking water to male Osborne-Mendel rats and female B6C3F1 mice. *Fund. Appl. Toxicol.* 5: 760-769.
- Land, P.D., E.L. Owen and H.W. Linde. 1981. Morphological changes in mouse spermatozoa after exposure to inhalational anesthetics during early spermatogenesis. *Anesthesiology* 54: 53-56.
- Lundberg, I., M. Ekdahl, T. Kronevi, et al. 1986. Relative hepatotoxicity of some industrial solvents after intraperitoneal injection or inhalation exposure to rats. *Environ. Res.* 40: 411-420. (Cited in ATSDR, 1989)
- Munson, A.E., L.E. Sain, V.M. Sanders, et al. 1982. Toxicology of organic drinking water contaminants: Trichloromethane, bromodichloromethane, dibromochloromethane, and tribromomethane. *Environ. Health Perspect.* 46: 117-126.
- Murray, A.E., B.A. Schwetz, J.G. McBride and R.E. Staples. 1979. Toxicity of inhaled chloroform in pregnant mice and their offspring. *Toxicol. Appl. Pharmacol.* 50: 515-522.
- NCI (National Cancer Institute). 1976. Report on Carcinogenesis Bioassay of Chloroform. National Cancer Institute, Washington, DC. NTIS PB 264018.
- Palmer, A.K., A.E. Street, F.J.C. Roe, et al. 1979. Safety evaluation of toothpaste containing chloroform. II. Long term studies in rats. *J. Environ. Path. Toxicol.* 2: 821-833.
- Reuber, M.D. 1979. Carcinogenicity of chloroform. *Environ. Health Perspect.* 31: 171-182. (Cited in U.S. EPA, 1985)
- Roe, F.J.C., A.A.K. Palmer, A.N. Worden, et al. 1979. Safety evaluation of toothpaste containing chloroform. I. Long-term studies in mice. *J. Environ. Toxicol.* 2: 799-819.
- Schroeder, H.G. 1965. Acute and delayed chloroform poisoning. A case report. *Br. J. Anaesth.* 37: 972-975.
- Schwetz, B.A., B.K.L. Leong and P.J. Gehring. 1974. Embryo- and fetotoxicity of inhaled chloroform in rats. *Toxicol. Appl. Pharmacol.* 28: 442-451.
- Taylor, D.C., D.M. Brown, R. Keeble, et al. 1974. Metabolism of chloroform. II. A sex difference in the metabolism of [ $^{14}\text{C}$ ]-chloroform in mice. *Xenobiotica* 4: 165-174.
- Thompson, D.J., S.D. Warner and V.B. Robinson. 1974. Teratology studies on orally administered chloroform in the rat. *Toxicol. Appl. Pharmacol.* 29: 348-357.

Torkelson, T.R. and V.K. Rowe. 1981. Halogenated aliphatic hydrocarbons containing chlorine, bromine and iodine. In: G.D. Clayton and E. Clayton, Eds. Patty's Industrial Hygiene and Toxicology, Vol. 2B. John Wiley & Sons, New York, pp. 3462-3469.

Torkelson, T.R., F. Oyen and V.K. Rowe. 1976. The toxicity of chloroform as determined by single and repeated exposure of laboratory animals. Am. Ind. Hyg. Assoc. 37: 697-704.

U.S. Air Force. 1989. Chloroform. In: The Installation Restoration Program Toxicology Guide, Vol. 1. Wright-Patterson Air Force Base, Ohio, pp. 4-1 to 4-41.

U.S. EPA. 1985. Health Assessment Document for Chloroform. Final Report. Office of Health and Environmental Assessment, Washington, DC. EPA/600/8-84/004F, NTIS PB86-105004/XAB.

U.S. EPA. 1992a. Health Effects Assessment Summary Tables. Annual FY-92. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Emergency and Remedial Response, Washington, DC.

U.S. EPA. 1992b. Chloroform. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH.

U.S. FDA (U.S. Food and Drug Administration). 1976. Chloroform as an ingredient of human drug and cosmetic products. Fed. Reg. 41: 26842-26845.

Wallace, C.J. 1950. Hepatitis and nephrosis due to cough syrup containing chloroform. Calif. Med. 73:442. (Cited in ATSDR, 1989)

**TOXICITY SUMMARY FOR  
CHRYSENE**

December 1994

Prepared by

H. T. Borges, Ph.D., MT(ASCP), D.A.B.T.  
Chemical Hazard Evaluation Group  
Biomedical and Environmental Information Analysis Section  
Health Sciences Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee 37830

Prepared for

U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Technology Demonstration and Transfer Branch  
Environmental Technology Division  
U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

---

\*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under  
Contract No. DE-AC05-84OR21400

## EXECUTIVE SUMMARY

Chrysene, a polycyclic aromatic hydrocarbon, is a ubiquitous environmental contaminant formed primarily by the incomplete combustion of organic compounds. Although present in coal and oil, the presence of chrysene in the environment is the result of anthropogenic activities such as coal combustion and gasification; gasoline exhaust, diesel and aircraft exhaust; and emissions from coke ovens, wood burning stoves, and waste incineration (IARC, 1983; ATSDR, 1990). Chrysene is not produced or used commercially and its use is limited strictly to research applications.

Little information on the absorption, distribution, metabolism and excretion of chrysene in humans is available. Animal studies have shown that approximately 75% of the administered chrysene may be absorbed by oral, dermal, or inhalation routes (Grimmer et al., 1988; Modica et al., 1983; Chang, 1943). Following its absorption, chrysene is preferentially distributed to highly lipophilic regions of the body, most notably adipose and mammary tissue (Bartosek et al., 1984; Modica et al., 1983). Phase I metabolism of chrysene, whether in the lung, skin, or liver, is mediated by the mixed function oxidases. The metabolism results in the formation of 1,2-, 3,4-, and 5,6-dihydrodiols as well as the formation of 1-, 3-, and 4-phenol metabolites (Sims, 1970; Nordquist et al., 1981; Jacob et al., 1982, 1987). Additional Phase I metabolism of chrysene 1,2-dihydrodiol forms chrysene 1,2-dihydrodiol-3,4-epoxide and 9-hydroxychrysene 1,2-diol-3,4-oxide. These metabolites were shown to have mutagenic and alkylating activity (Hodgson et al., 1983; Wood et al., 1977; Wood et al., 1979). Phase II metabolism of chrysene results in the formation of glucuronide and sulfate ester conjugates; however, glutathione conjugates of diol- and triol-epoxides are also formed (Sims and Grover, 1974, 1981; Hodgson et al., 1986; Robertson and Jernström, 1986). Hepatobiliary secretion with elimination in the feces is the predominant route of excretion (Schlede et al., 1970; Grimmer et al., 1988).

Human or animal systemic, developmental, and reproductive health effects following exposure to chrysene were not identified. Because of the lack of systemic toxicity data, the reference dose (RfD) and the reference concentration (RfC) for chrysene have not been derived (U.S. EPA, 1994a,b). Target organs have not been described, although chrysene may induce immunosuppression similar to certain other PAHs. Oral and inhalation carcinogenic bioassays were not identified. In mouse skin painting studies, chrysene was an initiator of papillomas and carcinomas. In addition, intraperitoneal injections of chrysene have induced liver adenomas and carcinomas in male CD-1 and BLU/Ha Swiss mice. Although oral and inhalation slope factors have not been derived, U.S. EPA (1994a,b) has classified chrysene in weight-of-evidence Group B2; probable human carcinogen, based on the induction of liver tumors and skin papillomas and carcinomas following treatment and the mutagenicity and chromosomal abnormalities induced in *in vitro* tests.

## 1. INTRODUCTION

Chrysene (CAS Number 218-01-9), a polycyclic aromatic hydrocarbon (PAH), is also known by the synonyms 1,2-benzophenanthrene, benzo[a]phenanthrene, 1,2-benzphenanthrene, 1,2-benz[a]phenanthrene, and 1,2,5,6-dibenzonaphthalene. Pure chrysene has a molecular weight of 228 g/mol and is a colorless orthorhombic bipyramidal crystalline solid that strongly fluoresces red-blue under ultraviolet light. Chrysene has a melting point of 255°C, a boiling point of 448°C, a density of 1.274 g/cm<sup>3</sup>, and a vapor pressure of 6.3x10<sup>-9</sup> mm Hg (Weast, 1988). It is virtually insoluble in water; only slightly soluble in alcohol, ether, carbon bisulfide or glacial acetic acid; and moderately soluble in benzene (Budavari et al., 1989). Chrysene is not used or produced commercially. It is used primarily in research applications.

Chrysene is a ubiquitous environmental contaminant that occurs as a product of the incomplete combustion of organic compounds. Environmental anthropogenic sources of chrysene include gasoline, diesel and aircraft turbine exhausts; coal combustion and gasification; emissions from coke ovens, wood burning stoves, and waste incineration; and various industrial applications such as iron, aluminum and steel production. Chrysene is also a constituent of coal, oil and their distillates such as coal tar, and creosote (IARC, 1983; ATSDR, 1990). Nonanthropogenic sources of chrysene include forest and grass fires, as well as volcanoes; however, these latter sources do not contribute significantly to the total environmental concentration of chrysene (ATSDR, 1990).

Humans are exposed to chrysene by oral, inhalation, and dermal routes. Exposure occurs through the consumption of fruits and vegetables grown in areas with high soil or atmospheric concentrations of chrysene and from drinking or using water contaminated with chrysene. Meats, particularly those with high fat contents, contribute significant quantities of chrysene to the diet from the pyrolysis of fats during the cooking process. Foods smoked or cooked over open coals contain even greater concentrations. Significant exposure to chrysene also occurs through the inhalation of mainstream and sidestream cigarette smoke (IARC, 1983). Occupational exposure to chrysene occurs during tar production, or from coking plants, coal gasification, smoke houses and smoked meat production, road and roof-tarring, incinerators, and aluminum production.

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

Information on the absorption of chrysene in humans was not found. However, the detection of PAHs, including chrysene and its metabolites, in the urine of individuals who smoke (Becher, 1986), work in industrial environments having high atmospheric concentrations (Becher and Bjorseth, 1983), or use therapeutic coal-tar creams (Clonfero et al., 1986) provides indirect evidence of inhalation and dermal absorption. Animal studies show that oral, inhalation and dermal absorption of chrysene occurs. Up to 74% of the administered dose of chrysene was recovered in the urine and feces of rats following oral, gavage or intratracheal instillation (Grimmer et al., 1988; Modica et al., 1983; Chang, 1943). Chrysene was detected in the urine of Osborne-Mendel rats following intrapulmonary instillation (Grimmer et al., 1988).

### 2.2. DISTRIBUTION

The distribution of chrysene has not been studied in humans. After oral treatment, peak concentrations of chrysene were found in rat blood and liver one hour after treatment. The concentration in the liver was 4-10 times higher than that in the blood (Bartosek et al., 1984; Modica et al., 1983). After redistribution, the tissue concentration of chrysene was related to the lipid content. The highest concentrations were found three hours after treatment in the adipose tissue followed in order by mammary tissue, brain, liver and blood (Bartosek et al., 1984; Modica et al., 1983). The concentration of chrysene in tissues was not dose-related. This suggests saturation of absorption mechanisms.

## 2.3. METABOLISM

*In vitro* studies have established that Phase I metabolism of chrysene is mediated by the mixed function oxidase system. In rat liver preparations, the 1,2-, 3,4-, and 5,6-dihydrodiol, as well as the 1-, 3-, and 4-phenol derivatives were the primary metabolites formed (Sims, 1970; Nordquist et al., 1981; Jacob et al., 1982, 1987). These same metabolites were also identified in human (Weston et al., 1985) and mouse skin studies (Weston et al., 1985; Hodgson et al., 1983). Arene oxide intermediates of chrysene have not been isolated, although the metabolic formation of the dihydrodiols and phenols provides indirect evidence of their existence (Sims and Grover, 1974; 1981). In mouse and human skin preparations (Weston et al., 1985; Hodgson et al., 1986), hamster cells (Phillips et al., 1986) and rat liver preparations (Hodgson et al., 1985; Nordquist et al., 1981), further oxidation of the 1,2-dihydrodiol of chrysene by cytochrome P-450 yields 1,2-dihydrodiol-3,4-epoxide. Additional metabolism of chrysene to form 9-hydroxychrysene 1,2-dihydrodiol-3,4-oxide has not been detected in humans, but has been reported to occur in mouse skin (Weston et al., 1985; Hodgson et al., 1986), hamster cells (Phillips et al., 1986) and rat liver preparations (Hodgson et al., 1985; Nordquist et al., 1981). In recent *in vivo* and *in vitro* studies, it was reported that chrysene can undergo bioalkylation and hydroxylation to form 6-methylchrysene and 6-hydroxymethylchrysene in rat liver cytosol and rat dorsal subcutaneous tissue (Myers and Flesher, 1991). Chrysene 1,2-dihydrodiol-3,4-epoxide and 9-hydroxychrysene 1,2-dihydrodiol-3,4-oxide are alkylating agents (Hodgson et al., 1985) and along with metabolically activated chrysene 1,2-dihydrodiol, possess mutagenic activity in *in vitro* bacterial and mammalian cell systems (Wood et al., 1977; Wood et al., 1979; Cheung et al., 1993).

Phase II metabolism of chrysene results in the formation of sulfate ester and glucuronide conjugates of the dihydrodiols and phenols formed during Phase I metabolism (Sims and Grover, 1974, 1981). Glutathione conjugates, from the conjugation of diol- and triol-epoxides of chrysene, have also been identified (Hodgson et al., 1986; Robertson and Jernström, 1986).

## 2.4. EXCRETION

The excretion of chrysene has not been extensively studied. However, it is likely similar to the hepatobiliary excretion with elimination in the feces as reported for other PAHs (Schlede et al., 1970). In rats treated with 50 µg chrysene by gavage or with 400 or 800 ng chrysene by intratracheal instillation, 74%, 53%, and 73%, respectively, of the dose were excreted within three days of treatment (Grimmer et al., 1988). Approximately 90% of the excreted chrysene was recovered in the feces within 24 hours of treatment.

# 3. NONCARCINOGENIC HEALTH EFFECTS

## 3.1. ORAL EXPOSURES

### 3.1.1. Acute Toxicity

Information on the acute oral toxicity of chrysene to humans or animals was unavailable.

### **3.1.2. Subchronic Toxicity**

Information on the subchronic oral toxicity of chrysene to humans or animals was unavailable.

### **3.1.3. Chronic Toxicity**

Information on the chronic oral toxicity of chrysene to humans or animals was unavailable.

### **3.1.4. Developmental and Reproductive Toxicology**

Information on the developmental and reproductive toxicity of chrysene to humans or animals following oral exposure was unavailable.

### **3.1.5. Reference Dose**

A Reference Dose for chrysene is unavailable at this time (U.S. EPA, 1994a,b).

## **3.2. INHALATION EXPOSURES**

### **3.2.1. Acute Toxicity**

Information on the acute inhalation toxicity of chrysene to humans or animals was unavailable.

### **3.2.2. Subchronic Toxicity**

Information on the subchronic inhalation toxicity of chrysene to humans or animals was unavailable.

### **3.2.3. Chronic Toxicity**

Information on the chronic inhalation toxicity of chrysene to humans or animals was unavailable.

### **3.2.4. Developmental and Reproductive Toxicity**

Information on the developmental and reproductive toxicity of chrysene to humans or animals following inhalation exposure was unavailable.

### **3.2.5. Reference Concentration**

A Reference Concentration for chrysene is unavailable at this time (U.S. EPA, 1994a,b).

## **3.3. OTHER ROUTES OF EXPOSURE**

Information on the toxicity of chrysene to humans or animals from other routes of exposure was unavailable.



### **3.4. TARGET ORGANS/CRITICAL EFFECTS**

#### **3.4.1. Oral Exposures**

##### **3.4.1.1. Primary Target Organs**

Studies that describe specific target organs of chrysene toxicity after oral treatments were not identified. However, inferences from the study of other PAHs can be made.

Immune System: Typically, carcinogenic PAHs induce immunosuppression in laboratory animals, whereas noncarcinogenic PAHs do not (Dean et al., 1986). Whether chrysene, a weakly carcinogenic PAH, induces immunosuppression after oral treatment is not known. White et al. (1985) has reported that antibody formation was not decreased in female B6C3F<sub>1</sub> mice that received chrysene by subcutaneous injection.

##### **3.4.1.2. Other Target Organs**

Other target organs following oral exposure to chrysene have not been described.

#### **3.4.2. Inhalation Exposures**

##### **3.4.2.1. Primary Target Organs**

Studies that describe specific target organs of chrysene toxicity after inhalation exposures were not identified. However, inferences from the study of other PAHs can be made.

Immune System: Typically, carcinogenic PAHs induce immunosuppression in laboratory animals, whereas noncarcinogenic PAHs do not (Dean et al., 1986). Whether chrysene, a weakly carcinogenic PAH, induces immunosuppression after inhalation exposure is not known. White et al. (1985) has reported that antibody formation was not decreased in female B6C3F<sub>1</sub> mice that received chrysene by subcutaneous injection.

##### **3.4.2.2. Other Target Organs**

Other target organs following inhalation exposure to chrysene have not been described.

## **4. CARCINOGENICITY**

Numerous epidemiologic studies have been done that investigated the increased incidence of tumors in individuals exposed to PAH emissions from coke ovens and various tars (Lloyd, 1971, Redmond et al., 1972, Mazumdar et al., 1975; Hammond et al., 1976; MacIure and MacMahon, 1980). It must be remembered that these studies are conducted on mixtures containing other PAHs and known carcinogens from chemically unrelated species. Therefore, these studies do not provide direct evidence for the carcinogenicity of chrysene.

### **4.1. ORAL EXPOSURES**

Information on the carcinogenicity of chrysene following oral exposure to humans or animals was unavailable.

## 4.2. INHALATION EXPOSURES

Information on the carcinogenicity of chrysene following inhalation exposure to humans or animals was unavailable. However, Wenzel-Hartung et al. (1990) studied the carcinogenicity of chrysene in female Osborne-Mendel rats that received a single intrapulmonary injection of 1 mg or 3 mg chrysene in a beeswax/trioctanoin vehicle. The median survival time of rats treated with chrysene was slightly decreased (96 weeks and 95 weeks for rats treated with 1 mg and 3 mg, respectively) when compared to control rats (100 weeks and 105 weeks for vehicle-treated and untreated rats, respectively). Dose-dependent increases in the incidence of lung carcinomas were observed in chrysene-treated rats [5/35 (14.3%) and 10/35 (28.6%) in rats treated with 1 mg and 3 mg chrysene, respectively], however, the tumor types were not described. No tumors were observed in either group of control rats. Based on the results of this study, the authors calculated a carcinogenic potency of 0.03 for chrysene relative to benzo[a]pyrene (1.0) and an effective dose in 10% of the animals ( $ED_{10}$ ) for carcinogenicity of 1.015 mg.

## 4.3. OTHER ROUTES OF EXPOSURE

Numerous bioassays assessing the carcinogenicity of chrysene in rats and mice following dermal, subcutaneous, and intraperitoneal treatment have been conducted. In general, these assays have established chrysene as a weak carcinogen relative to other PAHs. However, two metabolites of chrysene, chrysene-1,2-diol-3,4-epoxide and 9-hydroxychrysene 1,2-diol-3,4-oxide, have been shown to induce more tumors than chrysene, to be stronger alkylating agents, and to possess mutagenic activity in *in vitro* bacterial assays (Chang et al., 1983; Slaga et al., 1980; Buening et al., 1979; Levin et al., 1978).

In two carcinogenicity bioassays, chrysene administered by intraperitoneal injection produced a significant dose-related increase in the incidence of liver adenomas and carcinomas in treated CD-1 and BLU/Ha male mice (Wislocki et al., 1986; Buening et al., 1979). Additionally, chrysene increased the incidence of malignant lymphoma in low-dose male mice (160  $\mu$ g/mouse) and lung adenomas/carcinomas in high-dose male mice (640  $\mu$ g/mouse) relative to concurrent control CD-1 mice (Wislocki et al., 1986). Increased tumor incidences were not found in female mice in the Wislocki et al. (1986) or Buening et al. (1979) studies.

In numerous skin painting carcinogenicity bioassays, chrysene was shown to initiate skin papillomas and carcinomas in various mouse strains (C3H, ICR/Ha Swiss, Ha/ICR/Mil Swiss, CD-1, and Sencar) when treatments were followed by decahydronaphthalene, croton oil, or phorbol myristate acetate promotion (Van Duuren et al., 1966; Hecht et al., 1974; Levin et al., 1978; Wood et al., 1979; Wood et al., 1980). One study reported that chrysene is a complete carcinogen (possessing initiating and promoting activity) (Wynder and Hoffmann, 1959). In this study, application of 1% chrysene to the backs of female Swiss mice 3 times/week for the remainder of their life increased the incidence of skin papillomas and carcinomas. Since the purity of the chrysene was not reported, the tumors may have been induced by other PAHs or non-metabolic methyl derivatives of chrysene. Therefore, the results of this study are not conclusive.

## 4.4. EPA WEIGHT-OF-EVIDENCE

Classification – B2; probable human carcinogen (U.S. EPA, 1994a).

Basis – There were no human data, but sufficient animal bioassays show chrysene induces carcinomas and malignant lymphomas in mice following intraperitoneal injection and skin carcinomas following dermal exposure. Chrysene produced chromosomal abnormalities in hamster and mouse germ cells after gavage exposure and produced positive results in bacterial mutagenicity assays and transformed mammalian cells exposed in culture (U.S. EPA, 1990a).

## 4.5. SLOPE FACTORS

#### **4.5.1. Oral**

A slope factor for chrysene following oral exposure is unavailable (U.S. EPA, 1994a,b).

#### **4.5.2. Inhalation**

A slope factor for chrysene following inhalation exposure is unavailable (U.S. EPA, 1994a,b).

## 5. REFERENCES

- ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Chrysene. Prepared by Clement Assoc., Inc. under contract 205-88-0608. U.S. Public Health Service. ATSDR/TP-88/11.
- Bartosek, I., A. Guaitani, R. Modica, M. Fiume and R. Urso. 1984. Comparative kinetics of oral benz(a)anthracene, chrysene and triphenylene in rats: Study with hydrocarbon mixtures. *Toxicol. Lett.* 23: 333-339.
- Becher, G. and A. Bjorseth. 1983. Determination of exposure to polycyclic aromatic hydrocarbons by analysis of human urine. *Cancer Lett.* 17: 301-311.
- Becher, G. 1986. Determination of exposure to PAH by analysis of urine samples. In: Mechanisms in Tobacco Carcinogenesis, D. Hoffmann and C.C. Harris, Eds., Banbury Report, Cold Spring Harbor Laboratory, New York.
- Budavari, S., M.J. O'Neil, A. Smith and P.E. Heckelman. 1989. In: The Merck Index, 11th ed., Merck & Co., Inc., Rahway, NJ, p. 350.
- Buening, M.K., W. Levin, J.M. Karle, H. Yagi, D.M. Jerina, and A.H. Conney. 1979. Tumorigenicity of bay-region epoxides and other derivatives of chrysene and phenanthrene in newborn mice. *Cancer Res.* 39: 5063-5068.
- Chang, R.L., W. Levin, A.W. Wood, et al. 1983. Tumorigenicity of enantiomers of chrysene 1,2-dihydrodiol and of the diastereomeric bay-region chrysene 1,2-diol-3,4-epoxides on mouse skin and in newborn mice. *Cancer Res.* 43: 192-196.
- Chang, L.H. 1943. The fecal excretion of polycyclic hydrocarbons following their administration to the rat. *J. Biol. Chem.* 151: 93-99. (Cited in ATSDR, 1990)
- Cheung, Y-L., T.J.B. Gray, and C. Ioannides. 1993. Mutagenicity of chrysene, its methyl and benzo derivatives, and their interactions with cytochromes P-450 and the Ah-receptor; relevance to their carcinogenic potency. *Toxicology* 81: 69-86.
- Clonfero, E., M. Zordan, D. Cottica, et al. 1986. Mutagenic activity and polycyclic aromatic hydrocarbon levels in urine of humans exposed to therapeutical coal tar. *Carcinogenesis* 7: 819-823.
- Dean, J.H., M. J. Murray and E.C. Ward. 1986. Toxic Responses of the Immune System. In: Casarett and Doull's Toxicology: The Basic Science of Poisons, Third Edition, C.D. Klaassen, M.O. Amdur and J. Doull, Eds., Macmillian Publishing Co., New York, NY, pp. 271-272.
- Grimmer, G., H. Brune, G. Dettbarn, et al. 1988. Urinary and faecal excretion of chrysene and chrysene metabolites by rats after oral, intraperitoneal, intratracheal or intrapulmonary application. *Arch. Toxicol.* 62: 401-405.
- Hammond, E.D., I.J. Selikoff, P.O. Lawther, and H. Seidman. 1976. Inhalation of B[a]P and cancer in man. *Ann. NY Acad. Sci.* 271: 116-124. (Cited in ATSDR, 1990)
- Hecht, S.S., W. E. Bondinell and D. Hoffmann. 1974. Chrysene and methyl chrysenes: Presence in tobacco smoke and carcinogenicity. *J. Natl. Cancer Inst.* 53: 1121-1133.

Hodgson, R.M., A. Weston, and P.L. Grover. 1983. Metabolic activation of chrysene in mouse skin: Evidence for the involvement of triol-epoxide. *Carcinogenesis* 4: 1639-1643.

Hodgson, R.M., A. Seidel, W. Bochnitschek, H.R. Glatt, F. Oesch, and P.L. Grover. 1985. The formation of 9-hydroxychrysene-1,2-diol as an intermediate in the metabolic activation of chrysene. *Carcinogenesis* 6: 135-139.

Hodgson, R.M., A. Seidel, W. Bochnitschek, H.R. Glatt, F. Oesch, and P.L. Grover. 1986. Metabolism of the bay-region diol-epoxide of chrysene to a triol-epoxide and the enzyme-catalyzed conjugation of these epoxides with glutathione. *Carcinogenesis* 7: 2095-2098.

IARC (International Agency for Research on Cancer). 1983. In: IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans: Polynuclear Aromatic Compounds, Part I, Chemical, Environmental and Experimental Data, Vol. 32, IARC, Lyon, France, pp. 247-261.

Jacob, J., A. Schmoldt and G. Grimmer. 1982. Formation of carcinogenic and inactive chrysene metabolites by rat liver microsomes of various monooxygenase activities. *Arch. Toxicol.* 51: 255-265.

Jacob, J., A. Schmoldt, M. Hamann, G. Raab, and G. Grimmer. 1987. Monooxygenase induction by various xenobiotics and its influence on rat liver microsomal metabolism of chrysene in comparison to benz[a]anthracene. *Cancer Lett.* 34: 91-102.

Levin, W., A.W. Wood, R.L. Chang, et al. 1978. Evidence for bay region activation of chrysene 1,2-dihydrodiol to an ultimate carcinogen. *Cancer Res.* 38: 1831-1834.

Lloyd, J.W. 1971. Long-term mortality study of steel workers. V. Respiratory cancer in coke plant workers. *J. Occup. Med.* 13: 53-68. (Cited in ATSDR, 1990)

Maclure, K.M. and B. MacMahon. 1980. An epidemiologic perspective of environmental carcinogenesis. *Epidemiol. Rev.* 2: 19-48. (Cited in ATSDR, 1990)

Mazumdar, S., C.K. Redmond, W. Sollecito, and N. Sussman. 1975. An epidemiological study of exposure to coal tar pitch volatiles among coke oven workers. *J. Air Pollut. Control. Assoc.* 25: 382-389. (Cited in ATSDR, 1990)

Modica, R., M. Fiume, A. Guaitani and I. Bartosek. 1983. Comparative kinetics of benz(a)anthracene, chrysene and triphenylene in rats after oral administration. I. Study with single compounds. *Toxicol. Lett.* 18: 103-109.

Myers, S.R. and J.W. Flesher. 1991. Metabolism of chrysene, 5-methylchrysene, 6-methylchrysene and 5,6-dimethylchrysene in rat liver cytosol, in vitro, and in rat subcutaneous tissue, in vivo. *Chem.-Biol. Interactions* 77: 203-221.

Nordquist, M., D.R. Thakker, K.P. Vyas, et al. 1981. Metabolism of chrysene and phenanthrene to bay-region diol epoxides by rat liver enzymes. *Mol. Pharmacol.* 19: 168-178.

Phillips, D.H., H. R. Glatt, A. Seidel, W. Bochnitschek, F. Oesch and P.L. Grober. 1986. Mutagenic potential of DNA adducts formed by diol-epoxides, triol-epoxides, and the K-region epoxide of chrysene in mammalian cells. *Carcinogenesis* 7: 1739-1743.

Redmond, C.K., CA. Ciocco, J.W. Lloyd, and H.W. Rush. 1972. Long-term mortality study of steelworkers. VI. Mortality from malignant neoplasms among coke oven workers. *J. Occup. Med.* 14: 621-629. (Cited in ATSDR, 1990)

Robertson, I.G.C. and B. Jernström. 1986. The enzymatic conjugation of glutathione with bay-region diol-epoxides of benzo[a]pyrene, benz[a]anthracene, and chrysene. *Carcinogenesis* 7: 1633-1636.

Schlede, E., R. Kuntzman, S. Haber, and A.H. Conney. 1970. Effect of enzyme induction on the metabolism and tissue distribution of benzo[a]pyrene. *Cancer Res.* 30: 2898-2904.

Sims, P. and P.L. Grover. 1974. Epoxides in polycyclic aromatic hydrocarbon metabolism and carcinogenesis. *Adv. Cancer Res.* 20: 165-274.

Sims, P. and P.L. Grover. 1981. Involvement of dihydrodiols and diol-epoxides in the metabolic activation of polycyclic hydrocarbons other than benzo[a]pyrene. *In: Polycyclic Hydrocarbons and Cancer. Vol. 3.* H.V. Gelboin and P.O.P. Ts'O, Eds. Academic Press, New York, NY, pp. 117-181. (Cited in ATSDR, 1990)

Sims, P. 1970. Qualitative and quantitative studies of the metabolism of a series of aromatic hydrocarbons by rat liver preparations. *Biochem. Pharmacol.* 19: 795-818.

Slaga, T.J., G.L. Gleason, G. Mills, et al. 1980. Comparison of the skin tumor-initiating activities of dihydrodiols and diol-epoxides of various polycyclic aromatic hydrocarbons. *Cancer Res.* 40: 1981-1984.

U.S. EPA (U.S. Environmental Protection Agency). 1994a. Chrysene. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH.

U.S. EPA (U.S. Environmental Protection Agency). 1994b. Health Effects Assessment Summary Tables (HEAST), Annual FY-94. Prepared by the Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington, DC.

Van Duuren, B.L., A. Sivak, A. Segal, L. Orris and L. Langseth. 1966. The tumor promoting agents of tobacco leaf and tobacco smoke condensate. *J. Natl. Cancer Inst.* 37: 519-526. (Cited in ATSDR, 1990)

Weast, R.C., Ed. 1988. *In: CRC (Chemical Rubber Company) Handbook for Chemistry and Physics*, 69th ed., M.J. Astle and W.H. Beyer, Assoc. Ed., CRC Press, Inc., Boca Raton, FL. p. C-209.

Wenzel-Hartung, R., H. Brune, G. Grimmer, P. Germann, J. Timm, and W. Wosniok. 1990. Evaluation of the carcinogenic potency of 4 environmental polycyclic aromatic compounds following intrapulmonary application in rats. *Exp. Pathol. (Jena)* 40: 221-227.

Weston, A., R.M. Hodgson, A.J. Hewer, R. Kuroda, and P.L. Grover. 1985. Comparative studies of the metabolic activation of chrysene in rodent and human skin. *Chem. Biol. Interact.* 54: 223-242.

White, K.L., H.H. Lysy, and M.P. Holsapple. 1985. Immunosuppression by polycyclic aromatic hydrocarbons: A structure-activity relationship in B6C3F<sub>1</sub> and DBA/2 mice. *Immunopharmacology* 9: 155-164.

Wislocki, P.G., E.S. Bagan, A.Y.H. Lu, et al. 1986. Tumorigenicity of nitrated derivatives of pyrene, benz[a]anthracene, chrysene and benzo[a]pyrene in the newborn mouse assay. *Carcinogenesis* 7: 1317-1322.

Wood, A.W., W. Levin, D. Ryan, et al. 1977. High mutagenicity of metabolically activated chrysene 1,2-dihydrodiol: Evidence for bay region activation of chrysene. *Biochem. Biophys. Res. Commun.* 78: 847-854.

Wood, A.W., W. Levin, R.L. Chang, et al. 1979. Mutagenicity and tumorigenicity of phenanthrene and chrysene epoxides and diol epoxides. *Cancer Res.* 39: 4069-4077.

Wood, A.W., R.L. Chang, W. Levin, et al. 1980. Mutagenicity and tumor-initiating activity of cyclopenta(c,d)pyrene and structurally related compounds. *Cancer Res.* 40: 642-649.

Wynder, E.L. and D. Hoffmann. 1959. A study of tobacco carcinogenesis. VII. The role of higher polycyclic hydrocarbons. *Cancer* 12: 1079-1086.

**TOXICITY SUMMARY FOR  
DIBENZ[*a,h*]ANTHRACENE**

May 1995

Prepared by

Rosmarie A. Faust, Ph.D.  
Chemical Hazard Evaluation Group  
Biomedical and Environmental Information Analysis Section  
Health Sciences Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for

U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Technology Demonstration and Transfer Branch  
Environmental Technology Division  
U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

---

\*Managed by Lockheed Martin Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400



## EXECUTIVE SUMMARY

Dibenz[*a,h*]anthracene is a polycyclic aromatic hydrocarbon (PAH) with five aromatic rings. There is no commercial production or known use of dibenz[*a,h*]anthracene. It occurs as a component of coal tars, shale oils, and soots (IARC, 1985) and has been detected in gasoline engine exhaust; coke oven emissions; cigarette smoke; charcoal broiled meats; vegetation near heavily travelled roads; and surface water and soils near hazardous waste sites (ATSDR, 1993; IARC, 1983).

Dibenz[*a,h*]anthracene is poorly absorbed from the gastrointestinal tract and is primarily excreted via feces (Chang, 1943). Following absorption, dibenz[*a,h*]anthracene is distributed to various tissues, with highest accumulation in the liver and kidneys (Daniel et al., 1967). Dibenz[*a,h*]anthracene is metabolized by mixed function oxidases to dihydrodiols. Epoxidation of the 3,4-dihydrodiol may lead to the formation of a diol-epoxide, the putative ultimate carcinogenic metabolite of dibenz[*a,h*]anthracene (Buening et al., 1979).

No human studies were available to evaluate the toxicity of dibenz[*a,h*]anthracene. In animals, depressed immune responses were observed in mice following single or multiple subcutaneous (s.c.) injections of dibenz[*a,h*]anthracene (White et al., 1985). Weekly s.c. injections of 0.05% dibenz[*a,h*]anthracene for 40 weeks produced lymphoid tissue changes, decreased spleen weights, and liver and kidney lesions in mice (Hoch-Ligeti, 1941). Weekly intramuscular injections of 20 mg/kg promoted the development of arteriosclerotic plaques in chickens (Penn and Snyder, 1988).

EPA has not derived an oral Reference Dose (RfD) or inhalation Reference Concentration (RfC) for dibenz[*a,h*]anthracene (U.S. EPA, 1995).

No epidemiologic studies or case reports addressing the carcinogenicity of dibenz[*a,h*]anthracene in humans were available. In animals, dibenz[*a,h*]anthracene has produced tumors by different routes of administration, having both local and systemic carcinogenic effects. After oral administration, dibenz[*a,h*]anthracene produced tumors at several sites. Male and female mice fed dibenz[*a,h*]anthracene (0.85 mg/day for males, 0.76 mg/day for females) in an aqueous olive oil emulsion developed pulmonary adenomatosis, alveologenic carcinomas of the lung, hemangio-endotheliomas of the pancreas and mesentery/abdominal lymph nodes, and mammary carcinomas (females) after 200 days (Snell and Stewart, 1962). A single oral dose of 1.5 mg dibenz[*a,h*]anthracene in polyethylene glycol produced a low incidence of forestomach papillomas in mice (Berenblum and Haran, 1955). Mammary carcinomas developed in mice treated by gavage with a total dose of 15 mg over a 15-week period (Biancifiori and Caschera, 1962).

Carcinogenic as well as tumor-initiating activity of dibenz[*a,h*]anthracene has been demonstrated in topical application studies with mice. Repeated dermal application of 0.001 to 0.01% solutions produced a high incidence of skin papillomas and carcinomas in mice (Wynder and Hoffmann, 1959; Van Duuren et al., 1967). In initiation-promotion assays, the compound was active as an initiator of skin carcinogenesis in mice (Buening et al., 1979; Platt et al., 1990). However, no skin tumors were observed in Syrian golden hamsters that received topical dibenz[*a,h*]anthracene applications over a 10-week period (Shubik et al., 1960).

Injection site sarcomas developed in mice injected s.c. with of dibenz[*a,h*]anthracene (Pfeiffer, 1977). In newborn mice, a single s.c. injection of dibenz[*a,h*]anthracene induced local sarcomas and lung adenomas (Platt et al., 1990) and three intraperitoneal injections induced a high incidence of pulmonary tumors (Buening et al., 1979). A number of earlier studies have also demonstrated the carcinogenicity of dibenz[*a,h*]anthracene when administered by various parenteral routes in several animal species (IARC, 1973).

Based on no human data and sufficient evidence for carcinogenicity in animals, EPA has assigned dibenz[*a,h*]anthracene a weight-of-evidence classification of B2, probable human carcinogen (U.S. EPA, 1995).

## 1. INTRODUCTION

Dibenz[*a,h*]anthracene (CAS No. 53-70-3), also referred to as 1,2,5,6-dibenz(*a,h*)anthracene, 1,2:4,6-dibenz(*a,h*)anthracene, 1,2:5,6-dibenz(*a,h*)anthracene, DB(*a,h*)A, or DBA is a polycyclic aromatic hydrocarbon (PAH) with five aromatic rings (ATSDR, 1993; Budavari et al., 1989). It has a molecular formula of  $C_{22}H_{14}$ , a molecular weight of 278.33, and a melting point of 266°C. Dibenz[*a,h*]anthracene exists as crystalline plates or leaflets and is insoluble in water, slightly soluble in alcohol and ether, and soluble in petroleum ether, benzene, toluene, xylene, oils and other organic solvents (Budavari et al., 1989). It has a vapor pressure of  $1 \times 10^{-10}$  mm Hg at 20°C and an estimated log octanol/water partition coefficient of 6.84 (Mabey et al., 1982).

There is no commercial production or known use of dibenz[*a,h*]anthracene. It occurs as a component of coal tars, shale oils, and soots (IARC, 1985) and has been detected in gasoline engine exhaust; coke oven emissions; cigarette smoke; charcoal broiled meats; vegetation near heavily travelled roads; and surface water and soils near hazardous waste sites (ATSDR, 1993; IARC, 1983). Dibenz[*a,h*]anthracene is one of a number of PAHs on EPA's priority pollutant list (U.S. EPA, 1991).

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

No human data and very limited animal data are available concerning the absorption of dibenz[*a,h*]anthracene. One animal study by Chang (1943) indicates that dibenz[*a,h*]anthracene is poorly absorbed from the gastrointestinal tract. Rats given dibenz[*a,h*]anthracene in starch solution by gavage (200 mg) or in the diet (250 mg) absorbed less than 10% of the administered dose.

### 2.2. DISTRIBUTION

Following gavage administration of radiolabeled dibenz[*a,h*]anthracene to rats, radioactivity was distributed to several tissues (Daniel et al., 1967). About 5% of the radiolabel entered the thoracic lymph duct within 24 hours with peak levels occurring at 3-4 hours. In blood plasma, peak levels were seen approximately 7 hours after dibenz[*a,h*]anthracene administration, suggesting metabolite reabsorption. The highest concentrations of radiolabel were found in the liver and kidneys, followed by adrenal glands, ovaries and blood. Maximum concentrations in these organs were not reached until 10 hours after dosing. Three to four days after dosing, radiolabel was found only in the adrenal glands, ovaries, and fat. Heidelberger and Weiss (1951) reported that 90 minutes after an intravenous injection of radiolabeled dibenz[*a,h*]anthracene, 89% of the radioactivity was found in the liver of mice.

### 2.3. METABOLISM

Dibenz[*a,h*]anthracene is metabolized by mixed function oxidases to dihydrodiols (Nordqvist et al., 1979; Slaga et al., 1980; Wood et al., 1978). The 3,4-dihydrodiol is the major metabolite formed from dibenz[*a,h*]anthracene by rat liver microsomes, representing 24% to 28% of the total metabolites (Buening et al., 1979). Other metabolites are the 1,2- and 5,6-dihydrodiols, representing 10% to 15% of total metabolites. The 3,4-dihydrodiol is thought to be the immediate metabolic precursor of the diol-epoxide of dibenz[*a,h*]anthracene, a compound designated as the ultimate carcinogenic metabolite of dibenz[*a,h*]anthracene. Platt et al. (1983) identified the 3,4-, 5,6-, and 1,2-diols as well as the 5-phenol and 5,4-oxide as potential metabolites of dibenz[*a,h*]anthracene.

## **2.4. EXCRETION**

Following gavage (200 mg) or dietary (250 mg) administration of dibenz[*a,h*]anthracene, rats excreted >90% of the dose in the feces (Chang, 1943).

## **3. NONCARCINOGENIC HEALTH EFFECTS**

### **3.1. ORAL EXPOSURES**

#### **3.1.1. Acute Toxicity**

Information on the acute oral toxicity of dibenz[*a,h*]anthracene in humans or animals was not available.

#### **3.1.2. Subchronic Toxicity**

Information on the subchronic oral toxicity of dibenz[*a,h*]anthracene in humans or animals was not available.

#### **3.1.3. Chronic Toxicity**

##### **3.1.3.1. Human**

Information on the chronic oral toxicity of dibenz[*a,h*]anthracene in humans was not available.

##### **3.1.3.2. Animal**

In a study designed to evaluate the occurrence of pulmonary adenomatosis in DBA/2 mice treated with dibenz[*a,h*]anthracene, Snell and Stewart (1962) observed that *ad libitum* ingestion of a water/olive oil emulsion containing 0.2 mg/mL dibenz[*a,h*]anthracene for 279 days (males) or 237 days (females) may have accelerated the development of calcareous pericarditis (see also Section 4.1.2.). This lesion is known to occur spontaneously in DBA/2 mice and to increase with age.

#### **3.1.4. Developmental and Reproductive Toxicity**

Information on the developmental and reproductive toxicity of dibenz[*a,h*]anthracene in humans or animals following oral exposure was not available.

#### **3.1.5. Reference Dose**

An oral Reference Dose (RfD) for dibenz[*a,h*]anthracene has not been derived.

### **3.2. INHALATION EXPOSURES**

#### **3.2.1. Acute Toxicity**

Information on the acute toxicity of dibenz[*a,h*]anthracene in humans or animals following inhalation exposure was not available.

### **3.2.2. Subchronic Toxicity**

Information on the subchronic toxicity of dibenz[*a,h*]anthracene in humans or animals following inhalation exposure was not available.

### **3.2.3. Chronic Toxicity**

Information on the chronic toxicity of dibenz[*a,h*]anthracene in humans or animals following inhalation exposure was not available.

### **3.2.4. Developmental and Reproductive Toxicity**

Information on the developmental and reproductive toxicity of dibenz[*a,h*]anthracene in humans or animals following inhalation exposure was not available.

### **3.2.5. Reference Concentration**

An inhalation reference concentration (RfC) for dibenz[*a,h*]anthracene has not been derived.

## **3.3. OTHER ROUTES OF EXPOSURE**

### **3.3.1. Acute Toxicity**

#### **3.3.1.1. Humans**

Information on the acute toxicity of dibenz[*a,h*]anthracene in humans by other routes of exposure was not available.

#### **3.3.1.2. Animals**

White et al. (1985) evaluated the immune response in mice following single or multiple subcutaneous (s.c.) injections of dibenz[*a,h*]anthracene using the antibody-forming cell response to sheep erythrocytes. A single injection of 1 mmol dibenz[*a,h*]anthracene resulted in a 71% depression of immune response. Fourteen daily injections of 160  $\mu$ mol reduced the immune response by 91% and produced a 44% reduction in absolute thymus weight.

Mice receiving three s.c. injections of either 50, 100, or 400 mg/kg of dibenz[*a,h*]anthracene over a 12-day period had reduced serum antibody levels (Malmgren et al., 1952). Depressed growth, persisting for at least 15 weeks, was reported in young rats that received one or two intraperitoneal (i.p.) injections of dibenz[*a,h*]anthracene at doses ranging from 3 to 90 mg/kg (Haddow et al., 1937).

As an indicator of potential carcinogenic activity, Bock and Mund (1958) measured the potency of a number of chemicals in suppressing sebaceous gland activity in mice. High levels of sebaceous gland suppression were seen when dibenz[*a,h*]anthracene was applied twice daily on three consecutive days to the skin of mice.

### **3.3.2. Subchronic Toxicity**

#### **3.3.2.1. Humans**

Information on the subchronic toxicity of dibenz[*a,h*]anthracene in humans by other routes of exposure was not available.

### **3.3.2.2. Animals**

Hoch-Ligeti (1941) administered dibenz[*a,h*]anthracene to mice by weekly s.c. injections (0.05 mL of a 0.05% solution in gelatin) for 40 weeks. Treatment with dibenz[*a,h*]anthracene caused an increase in the number of lymph gland stem cells, an overall decrease in lymphoid cells, dilation of lymphoid sinuses, and significantly decreased spleen weights. Additional effects included signs of fatty degeneration of the liver and deposition of iron in Kupffer cells; iron deposition in adrenal cortex; and signs of degeneration in kidney tubules and Malpighian bodies.

Rats given s.c. injections of 0.278 mg dibenz[*a,h*]anthracene 5 times weekly for several weeks exhibited pathological changes in the lymphoid tissues, characterized by extravascular red blood cells in the lymph spaces and by the presence of abnormally large pigmented cells (Lasnitzki and Woodhouse, 1944).

Weekly intramuscular (i.m.) injections of 20 mg/kg of dibenz[*a,h*]anthracene administered to male White Leghorn chickens for 16 weeks promoted the development of preexisting arteriosclerotic plaques, but did not initiate the development of new plaques (Penn and Snyder, 1988).

### **3.3.3. Chronic Toxicity**

Information on the chronic toxicity of dibenz[*a,h*]anthracene by other routes of exposure in humans or animals was not available.

### **3.3.4. Developmental and Reproductive Toxicity**

#### **3.3.4.1. Human**

Information on the developmental or reproductive toxicity of dibenz[*a,h*]anthracene by other routes of exposure in humans was not available.

#### **3.3.4.2. Animal**

Some degeneration of spermatogenic cells and the presence of "large" corpora lutea in the ovaries were observed in mice administered weekly s.c. injections of dibenz[*a,h*]anthracene (0.05 mL of a 0.05% solution in gelatin) for 40 weeks (Hoch-Ligeti, 1941).

## **3.4. TARGET ORGANS/CRITICAL EFFECTS**

### **3.4.1. Oral Exposures**

No data were available to identify target organs or critical effects following oral exposure to dibenz[*a,h*]anthracene.

### **3.4.2. Inhalation Exposures**

No data were available to identify target organs or critical effects following inhalation exposure to dibenz[*a,h*]anthracene.

### 3.4.3. Other Routes of Exposure

#### 3.4.3.1. Primary Target Organs

Lymphatic system: Subchronic exposure by s.c. injection produced lymphoid tissues changes in mice and rats.

#### 3.4.3.2. Other Target Organs

1. Liver: Subchronic exposure by s.c. injection produced fatty liver changes in mice.
2. Kidneys: Subchronic exposures by s.c. injection produced degenerative kidney tubule changes in mice.
3. Cardiovascular system: Subchronic exposure by i.m. injection promoted the development of preexisting arteriosclerotic plaques in chickens.

## 4. CARCINOGENICITY

### 4.1. ORAL EXPOSURES

#### 4.1.1. Human

Information on the carcinogenicity of dibenz[*a,h*]anthracene in humans following oral exposure was not available.

#### 4.1.2. Animal

Male and female DBA/2 mice (21/sex) were given 0.2 mg/mL dibenz[*a,h*]anthracene in an aqueous olive oil emulsion *ad libitum* in place of drinking water (Snell and Stewart, 1962). Males were estimated to have received a daily dose of 0.85 mg/day while females received 0.76 mg/day. The duration of the experiment was 279 or 237 days for males and females, respectively. The animals did not tolerate the olive-oil vehicle well and lost weight after a few weeks of exposure, becoming emaciated and dehydrated. At 200 days, all of the 27 survivors developed pulmonary adenomatosis, 24 had alveologenic carcinoma of the lung, 16 had hemangio-endotheliomas of the pancreas and mesentery/abdominal lymph nodes, and 12/13 females had mammary carcinomas. Also seen were precancerous growths of the small intestines. No mammary tumors, but two pulmonary adenomatoses were seen in 35 controls.

Twice weekly gavage administration of 0.5% dibenz[*a,h*]anthracene in olive oil (total dose, 15 mg) for 15 weeks produced mammary carcinomas in 1/20 female BALB/c mice and in 13/24 pseudo-pregnant females (obtained by mating virgin females with vasectomized males) (Biancifiore and Caschera, 1962). A single dose of 1.5 mg dibenz[*a,h*]anthracene in polyethylene glycol produced forestomach tumors in 2/42 male Swiss mice after 30 weeks. No tumors were seen in mice treated with polyethylene glycol alone (Berenblum and Haran, 1955).

## 4.2. INHALATION EXPOSURES

### 4.2.1. Human

Although there are no human data that specifically link exposure to dibenz[*a,h*]anthracene to human cancers, dibenz[*a,h*]anthracene is a component of mixtures that has been associated with human cancer. These include coal tar, soots, coke oven emissions, and cigarette smoke (U.S. EPA, 1995).

### 4.2.2. Animal

Information on the carcinogenicity of dibenz[*a,h*]anthracene in animals following inhalation exposure was not available.

## 4.3. OTHER ROUTES OF EXPOSURE

### 4.3.1. Human

Information on the carcinogenicity of dibenz[*a,h*]anthracene in humans by other routes of exposure was not available.

### 4.3.2. Animal

Dibenz[*a,h*]anthracene was the first pure chemical compound shown to be carcinogenic in animals (IARC, 1973). Carcinogenic activity of dibenz[*a,h*]anthracene has been demonstrated in numerous skin application and parenteral administration studies.

Application of dibenz[*a,h*]anthracene in acetone to the skin of NMRI mice (three times weekly at total doses of 136, 448, or 1358 nmol) for 12 weeks produced papillomas in 6%, 8%, or 32% of treated animals, respectively (Platt et al., 1990). Tumor-initiating activity was demonstrated when female NMRI mice received topical applications of dibenz[*a,h*]anthracene (300 or 600 nmol) followed by treatment with 12-*O*-tetradecanoyl-phorbol-13-acetate (TPA) for 24 weeks. The effect was dose-dependent, where doubling the dose resulted in a considerable increase of skin tumors as well as tumor yield and a decrease in latency period of the first tumor. Tumor-initiating activity was also observed when Sencar mice were treated with concentrations as low as 10 nmol followed by TPA applications (Buening et al., 1979). Lijinsky et al. (1965) reported that biweekly topical applications of a 0.2% solution of dibenz[*a,h*]anthracene (38 µg/dose) in acetone-benzene for 44 weeks induced skin papillomas and carcinomas in 16/20 female Swiss mice. Van Duuren et al. (1967) reported that topical applications of dibenz[*a,h*]anthracene in acetone (0.001%, 0.01%, or 0.1%, administered 3 times weekly for an unspecified period) produced skin tumors in 1/30 (1 carcinoma), 43/50 (39 carcinomas), or 39/40 (32 carcinomas), respectively. There was also a dose-related decrease in survival time and tumor latency period. Repeated skin applications of a 0.001% solution of dibenz[*a,h*]anthracene in acetone (duration of treatment not given) produced skin papillomas in 30% and carcinomas in 30% of mice, while a 0.01% solution produced both papillomas and carcinomas in over 90% of mice, with similar latency periods (Wynder and Hoffmann, 1959).

Hamsters appear to be more resistant to the tumorigenic properties of dibenz[*a,h*]anthracene than mice. Shubik et al. (1960) observed no skin tumors in Syrian golden hamsters receiving 20 topical applications of a 0.2% solution of dibenz[*a,h*]anthracene over a period of 10 weeks. Multiple intratracheal instillations of 0.05 or 0.25 mg dibenz[*a,h*]anthracene administered as 24 or 30 weekly doses, respectively, did not induce respiratory tract tumors in Syrian golden hamsters given the lower dose (Sellakumar and Shubik, 1974). Hamsters given the higher dose developed two adenocarcinomas (one each at week 45 and 108). The development of squamous cell carcinomas was reported in mice treated with dibenz[*a,h*]anthracene by intratracheal instillation (details not provided) (Yanisheva and Balenko, 1966).

A single s.c. injection of dibenz[*a,h*]anthracene (308 nmol/animal) led to the formation of fibrosarcomas at the injection site in 63% of treated adult NMRI mice (Platt et al., 1990). When newborn NMRI mice were given a single s.c. injection (400 nmol/animal) on day 2 of their life, 92% of treated animals developed lung adenomas after 40 weeks. Injection site sarcomas were reported in female NMRI mice following a single s.c. injection of as little as 2.35 µg dibenz[*a,h*]anthracene (Pfeiffer, 1977). In another s.c. injection study, Lubet et al. (1983) found that treatment with 150 µg dibenz[*a,h*]anthracene was associated with the development of fibrosarcomas, but only in some strains. Following a 9-month observation period, fibrosarcomas were observed in 80%, 33%, 3%, or 0% of C3H/HeJ, C57B1/6J, DBA/2J, or AKR/J mice, respectively. Newborn mice injected intraperitoneally on the 1st, 8th, and 15th days of life with dibenz[*a,h*]anthracene at total doses of 70 or 420 nmol, 88% and 100%, respectively, developed pulmonary tumors (Buening et al., 1979). A number of earlier studies summarized in IARC (1973) have also demonstrated the carcinogenicity of dibenz[*a,h*]anthracene when administered by various parenteral routes to several animal species.

Falk et al. (1964) evaluated the potential inhibitory effects of phenanthrene and other PAHs considered noncarcinogenic on the tumorigenicity of dibenz[*a,h*]anthracene. Male C57B1 mice received single s.c. injections of various dosages of dibenz[*a,h*]anthracene alone or in combination with other PAHs [hydrogenated dibenz(*a,h*)anthracenes]. Phenanthrene as well as hydrogenated dibenz(*a,h*)anthracenes exerted substantial inhibitory effects on the production of injection site sarcomas induced by dibenz[*a,h*]anthracene. In contrast, Pfeiffer (1977) found no inhibitory effects of ten noncarcinogenic PAHs in NMRI mice given single s.c. injections of dibenz(*a,h*)anthracene.

#### 4.4. EPA WEIGHT-OF-EVIDENCE

Classification -- B2, probable human carcinogen (U.S. EPA, 1995).

Basis -- Based on no human data and sufficient data from animal bioassays.

Dibenz[*a,h*]anthracene produced carcinomas in mice following oral or dermal exposure and injection site tumors in several species following s.c. or i.m. administration.

Dibenz[*a,h*]anthracene has induced DNA damage and gene mutations in bacteria as well as gene mutations and transformation in several types of mammalian cell cultures.

#### 4.5. CARCINOGENICITY SLOPE FACTORS

None were available.

### 5. REFERENCES

- ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). Draft for Public Comment. Update. Prepared by Clement International Corporation, under Contract No. 205-88-0608, for the U.S. Department of Health and Human Services, Public Health Service.
- Berenblum, I. and N. Haran. 1955. The influence of croton oil and of polyethylene glycol-400 on carcinogenesis in the forestomach of the mouse. *Cancer Res.* 15: 510-516. (Cited in U.S. EPA, 1991)
- Biancifiori, C. and F. Caschera. 1962. The relation between pseudo-pregnancy and the chemical induction of mammary and ovarian tumours in BALB/c mice. *Br. J. Cancer* 16: 722-730. (Cited in U.S. EPA, 1995)
- Bock, F.G. and R. Mund. 1958. A survey of compounds for activity in the suppression of mouse sebaceous glands. *Cancer Res.* 18: 887-892.



- Budavari, S., M.J. O'Neil and A. Smith, Eds. 1989. The Merck Index. Merck & Co., Rahway, NJ, p. 475.
- Buening, M.K., W. Levin, A.W. Wood, et al. 1979. Tumorigenicity of the dihydrodiols of dibenzo(a,h)anthracene on mouse skin and in newborn mice. *Cancer Res.* 39: 1310-1314.
- Chang, L.H. 1943. The fecal excretion of polycyclic hydrocarbons following their administration to the rat. *J. Biol. Chem.* 151: 93-99. (Cited in ATSDR, 1993)
- Daniel, P.M., O.E. Pratt and M.M.L. Prichard. 1967. Metabolism of labelled carcinogenic hydrocarbons in rats. *Nature* 215: 1142-1146.
- Falk, H.L., P. Kotin and S. Thompson. 1964. Inhibition of carcinogenesis. The effect of polycyclic hydrocarbons and related compounds. *Arch. Environ. Health* 9: 169-179.
- Haddow, A, C.M. Scott and J.D. Scott. 1937. The influence of certain carcinogenic and other hydrocarbons on body growth in the rat. *Proc. R. Soc. London B.* 122: 477-507. (Cited in U.S. EPA, 1991)
- Heidelberger, C. and S.M. Weiss. 1951. The distribution of radioactivity in mice following administration of 3,4-benzpyrene-5-C<sup>14</sup> and 1,2,5,6-dibenzanthracene-9-10-C<sup>14</sup>. *Cancer Res.* 11: 885-891.
- Hoch-Ligeti, C. 1941. Studies on the changes in the lymphoid tissue of mice treated with carcinogenic and noncarcinogenic hydrocarbons. *Cancer Res.* 1: 484-488.
- IARC (International Agency for Research on Cancer). 1973. Dibenzo(a,h)anthracene. In: IARC Monographs on the Evaluation of Carcinogenic Risk of the Chemical to Man. Certain Polycyclic Aromatic Hydrocarbons and Heterocyclic Compounds. Vol. 3. World Health Organization, Lyon, France, pp. 178-196.
- IARC (International Agency for Research on Cancer). 1983. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Polynuclear Aromatic Compounds, Part 1, Chemical, Environmental and Experimental Data, Vol. 32. World Health Organization, Lyon, France, pp. 33-224.
- IARC (International Agency for Research on Cancer). 1985. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Polynuclear Aromatic Compounds, Part 4, Bitumens, Coal-tars and Derived Products, Shale-oils and Soots, Vol. 35. In: IARC Monographs on the Evaluation of Carcinogenic Risk of the Chemical to Man. World Health Organization, Lyon, France, pp. 88, 91, 164, 225.
- Lasnitzki, A. and D.L. Woodhouse. 1944. The effect of 1:2:5:6-dibenzanthracene on the lymph-nodes of the rat. *J. Anat.* 78: 121-129.
- Lijinsky, W., H. Garcia, B. Terracini and U. Saffioti. 1965. Tumorigenic activity of hydrogenated derivatives of dibenz[a,h]anthracene. *J. Natl. Cancer Inst.* 34: 1-6.
- Lubet, R.A., G.M. Connolly, D.W. Nebert and R.E. Kouri. 1983. Dibenzo[a,h]anthracene-induced subcutaneous tumors in mice. Strain sensitivity and the role of carcinogen metabolism. *Carcinogenesis* 4: 513-517.
- Mabey W.R., J.H. Smith, R.T. Podoll, et al. 1982. Aquatic fate process data for organic priority pollutants. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, DC. EPA 440/4-81-014.

Malmgren, R.A., B.E. Bennison and T.W. McKinley, Jr. 1952. Reduced antibody titers in mice treated with carcinogenic and cancer chemotherapeutic agents. *Proc. Soc. Exp. Biol. Med.* 79: 484-488. (Cited in U.S. EPA, 1991)

Nordqvist, M., D.R. Thakker, M. Levin, et al. 1979. The highly tumorigenic 3,4-dihydrodiol is a principal metabolite formed from dibenzo[a,h]anthracene by liver enzymes. *Mol. Pharmacol.* 16: 643-655. (Cited in U.S. EPA, 1995)

Penn, A. and C. Snyder. 1988. Arteriosclerotic plaque development is 'promoted' by polynuclear aromatic hydrocarbons. *Carcinogenesis* 9: 2185-2189.

Pfeiffer, E.H. 1977. Oncogenic interaction of carcinogenic and non-carcinogenic polycyclic aromatic hydrocarbons in mice. In: *Air Pollution and Cancer in Man*, V. Mohr, et al., Eds. International Agency for Research on Cancer, Lyon, France, pp. 69-77. (Cited in U.S. EPA, 1991).

Platt, K.L., E.H. Pfeiffer, H.R. Glatt and F. Oesch. 1983. Bacterial mutagenicity and carcinogenicity of potential metabolites of dibenz[a,h]anthracene. *J. Cancer Res. Clin. Oncol.* 105: A23. (Cited in U.S. EPA, 1991)

Platt, K.L., E. Pfeiffer, P. Petrovic, et al. 1990. Comparative tumorigenicity of picene and dibenz[a,h]anthracene in the mouse. *Carcinogenesis* 11: 1721-1726.

Sellakumar, A. and P. Shubik. 1974. Carcinogenicity of different polycyclic hydrocarbons in the respiratory tract of hamsters. *J. Natl. Cancer Inst.* 53: 1713-1719.

Shubik, P., G. Pietra and G. Della Porta. 1960. Studies of skin carcinogenesis in the Syrian golden hamster. *Cancer Res.* 20: 100-105.

Slaga, T.J., G.L. Gleason, G. Mills, et al. 1980. Comparison of the skin tumor-initiating activities of dihydrodiols and diol-epoxides of various polycyclic aromatic hydrocarbons. *Cancer Res.* 40: 1981-1984.

Snell, K.C. and H.L. Stewart. 1962. Pulmonary adenomatosis induced in DBA/2 mice by oral administration of dibenz[a,h]anthracene. *J. Natl. Cancer Inst.* 28: 1043-1049.

U.S. EPA (U.S. Environmental Protection Agency). 1991. Drinking Water Criteria for Polycyclic Aromatic Hydrocarbons (PAHs). Prepared by the Environmental Criteria and Assessment, Office, Office of Health and Environmental Assessment, Cincinnati, OH, for the Office of Water, Washington, DC. ECAO-CIN-D010.

U.S. EPA (U.S. Environmental Protection Agency). 1995. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH.

Van Duuren, B.L., L. Langseth, B.M. Goldschmidt and L. Orris. 1967. Carcinogenicity of epoxides, lactones and peroxy compounds. VI. Structure and carcinogenic activity. *J. Natl. Cancer Inst.* 39: 1217. (Cited in IARC, 1973; U.S. EPA, 1991)

White, K.L., Jr., H.H. Lysy and M.P. Holsapple. 1985. Immunosuppression by polycyclic aromatic hydrocarbons: A structure-activity relationship in B6C3F1 and DBA/2 mice. *Immunopharmacol.* 9: 155-164.

Wood, A.W., W. Levin, P.E. Thomas, et al. 1978. Metabolic activation of dibenzo(*a,h*)anthracene and its dihydrodiols to bacterial mutagens. *Cancer Res.* 38: 1967-1973.

Wynder, E.L. and D. Hoffmann. 1959. A study of tobacco carcinogenesis. VII. The role of higher polycyclic hydrocarbons. *Cancer* 12: 1079-1086.

Yanisheva, N.Ya. and N.V. Balenko. 1966. Experimental lung cancer caused by introduction of various doses of 1,2,5,6-dibenzanthracene. *Gig. i Sanit.* 31: 12. (Cited in IARC, 1973)

**TOXICITY SUMMARY FOR  
INDENO[1,2,3-*cd*]PYRENE**

May 1994

Prepared by:

Rosmarie A. Faust, Ph.D.  
Chemical Hazard Evaluation Group  
Biomedical and Environmental Information Analysis Section  
Health Sciences Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for:

U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Environmental Branch, Technology Division  
U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

## EXECUTIVE SUMMARY

Indeno[1,2,3-*cd*]pyrene, a crystalline solid with a chemical formula of  $C_{22}H_{12}$  and a molecular weight of 276.3, is a polycyclic aromatic hydrocarbon (PAH). There is no commercial production or known use of this compound (IARC, 1983). Indeno[1,2,3-*cd*]pyrene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion (IARC, 1983) and has been identified in soils, groundwater, and surface waters at hazardous waste sites (ATSDR, 1990).

No absorption data were available for indeno[1,2,3-*cd*]pyrene; however, by analogy to structurally-related PAHs, primarily benzo[*a*]pyrene, it would be expected to be absorbed from the gastrointestinal tract, lungs, and skin (U.S. EPA, 1991). *In vivo* metabolites identified in mouse skin include the *trans*-1,2-dihydrodiol and 8- and 9-hydroxy forms of indeno[1,2,3-*cd*]pyrene (Rice et al., 1986). Similar metabolites were formed *in vitro* in rat liver microsomes (Rice et al., 1985).

No data were found concerning the acute, subchronic, chronic, developmental, or reproductive toxicity of indeno[1,2,3-*cd*]pyrene. Because of a lack of toxicity data, an oral reference dose (RfD) or inhalation reference concentration (RfC) has not been derived (U.S. EPA, 1994).

No long-term oral or inhalation bioassays were available to assess the carcinogenicity of indeno[1,2,3-*cd*]pyrene. The compound was tested for carcinogenicity in dermal application, lung implant, subcutaneous (s.c.) injection, and intraperitoneal (i.p.) injection studies. Dermal application of 0.1-0.5% solutions of indeno[1,2,3-*cd*]pyrene in acetone produced skin papillomas and carcinomas in mice (Hoffmann and Wynder, 1966). In initiation-promotion assays, indeno[1,2,3-*cd*]pyrene was active as an initiator of skin carcinogenesis (Hoffmann and Wynder, 1966; Rice et al., 1986). Dose-related increases of epidermoid carcinomas of the lungs were reported in rats receiving single lung implants of 0.16-4.15 mg indeno[1,2,3-*cd*]pyrene (Deutsch-Wenzel et al., 1983). Injection site sarcomas developed in mice given three s.c. injections of 0.6 mg indeno[1,2,3-*cd*]pyrene (Lacassagne et al., 1963). The compound was not tumorigenic when newborn mice received 2.1  $\mu$ mol indeno[1,2,3-*cd*]pyrene via i.p. injection (LaVoie et al., 1987).

Based on no human data and sufficient evidence for carcinogenicity in animals, EPA has assigned a weight-of-evidence classification of B2, probable human carcinogen, to indeno[1,2,3-*cd*]pyrene (U.S. EPA, 1994).

## 1. INTRODUCTION

Indeno[1,2,3-*cd*]pyrene (CAS Reg. No. 193-39-5), also known as IP, *ortho*-phenylenepyrene, 1,10-(*ortho*-phenylene)pyrene, 1,10-(1,2-phenylene)pyrene, and 2,3-*ortho*-phenylenepyrene (IARC, 1983), is a polycyclic aromatic hydrocarbon (PAH) with one five-membered ring and five six-membered rings. It is a crystalline solid with a chemical formula of C<sub>22</sub>H<sub>12</sub>, a molecular weight of 276.3, a melting point of 163.6°C (IARC, 1983), and a boiling point of 530°C (ATSDR, 1990). Indeno[1,2,3-*cd*]pyrene is insoluble in water, but is soluble in organic solvents. It has a vapor pressure of  $\sim 1 \times 10^{-10}$  torr at 20°C, an estimated octanol/water partition coefficient of 6.584, and a Henry's Law constant of  $6.95 \times 10^{-8}$  (ATSDR, 1990).

There is no commercial production or known use of indeno[1,2,3-*cd*]pyrene (IARC, 1983). The compound is found in fossil fuels and occurs ubiquitously in products of incomplete combustion. It has been detected in mainstream cigarette smoke; gasoline engine exhaust; emissions from the burning of coal; lubricating oils; used motor oils (IARC, 1983); and in soils, surface waters, and groundwater at hazardous waste sites (ATSDR, 1990). Indeno[1,2,3-*cd*]pyrene is one of a number of PAHs on EPA's priority pollutant list (ATSDR, 1990).

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

Data regarding the gastrointestinal or pulmonary absorption of indeno[1,2,3-*cd*]pyrene in humans or animals were not available. However, data from structurally-related PAHs, primarily benzo[*a*]pyrene, suggest that indeno[1,2,3-*cd*]pyrene would be absorbed from the gastrointestinal tract, lungs, and skin (U.S. EPA, 1991).

### 2.2. DISTRIBUTION

No human or animal data were available concerning the tissue distribution of indeno[1,2,3-*cd*]pyrene.

### 2.3. METABOLISM

In mouse skin, Rice et al. (1986) identified 8-hydroxyindeno[1,2,3-*cd*]pyrene as the most abundant metabolite; other major metabolites included 9-hydroxyindeno[1,2,3-*cd*]pyrene and *trans*-1,2-dihydro-1,2-dihydroxyindeno[1,2,3-*cd*]pyrene. In *in vitro* metabolism studies using rat liver microsomes, some metabolites identified included the *trans*-1,2-dihydrodiol of indeno[1,2,3-*cd*]pyrene, the *trans*-1,2-dihydrodiols of 8- and 9-hydroxy-indeno[1,2,3-*cd*]pyrene, and the 1,2-quinone form of indeno[1,2,3-*cd*]pyrene (Rice et al., 1985).

### 2.4. EXCRETION

No human or animal data were available concerning the excretion of indeno[1,2,3-*cd*]pyrene.

### **3. NONCARCINOGENIC HEALTH EFFECTS**

#### **3.1. ORAL EXPOSURES**

Information on the acute, subchronic, chronic, developmental, or reproductive oral toxicity of indeno[1,2,3-*cd*]pyrene in humans or animals was not available. Because of the lack of toxicity data, an oral reference dose (RfD) for indeno[1,2,3-*cd*]pyrene has not been derived (U.S. EPA, 1994).

#### **3.2. INHALATION EXPOSURES**

Information on the acute, subchronic, chronic, developmental, or reproductive toxicity of indeno[1,2,3-*cd*]pyrene in humans or animals following inhalation exposure was not available. Because of a lack of toxicity data, an inhalation reference concentration (RfC) for indeno[1,2,3-*cd*]pyrene has not been derived (U.S. EPA, 1994).

#### **3.3. OTHER ROUTES OF EXPOSURE**

Information on the acute, subchronic, chronic, developmental, or reproductive toxicity of indeno[1,2,3-*cd*]pyrene in humans or animals by other routes of exposure was not available.

#### **3.4. TARGET ORGANS/CRITICAL EFFECTS**

No data were available to identify target organs or critical effects for oral, inhalation, or other routes of exposure to indeno[1,2,3-*cd*]pyrene.

### **4. CARCINOGENICITY**

#### **4.1. ORAL EXPOSURES**

Information on the carcinogenicity of indeno[1,2,3-*cd*]pyrene in humans or animals following oral exposure was not available.

#### **4.2. INHALATION EXPOSURES**

##### **4.2.1. Human**

Although there are no human data that specifically link exposure to indeno[1,2,3-*cd*]pyrene to human cancers, indeno[1,2,3-*cd*]pyrene is a component of mixtures that have been associated with human cancer. These mixtures include coal tar, soots, coke oven emissions, and cigarette smoke (U.S. EPA, 1994).

##### **4.2.2. Animal**

Information on the carcinogenicity of indeno[1,2,3-*cd*]pyrene in animals following inhalation exposure was not available.

#### **4.3. OTHER ROUTES OF EXPOSURE**

##### **4.3.1. Human**

Information on the carcinogenicity of indeno[1,2,3-*cd*]pyrene in humans by other routes of exposure was not available.

#### 4.3.2. Animal

Indeno[1,2,3-*cd*]pyrene was tested for carcinogenicity in skin application, initiation-promotion, lung implant, subcutaneous (s.c.) injection, and intraperitoneal (i.p.) injection bioassays.

Hoffmann and Wynder (1966) applied solutions of indeno[1,2,3-*cd*]pyrene in dioxane or acetone to the skin of groups of 20 female Swiss albino mice. Solutions of 0.05 or 0.1% indeno[1,2,3-*cd*]pyrene in dioxane did not induce skin tumors, whereas acetone solutions induced a dose-related increased incidence of skin tumors. No tumors were observed following treatment with 0.01 or 0.05% solutions in acetone; a concentration 0.1% induced six papillomas and three carcinomas beginning at 9 months; and a concentration of 0.5% induced seven papillomas and five carcinomas, with the first tumor appearing after 3 months. By contrast, repeated topical application of up to 9.2  $\mu\text{g}$  of indeno[1,2,3-*cd*]pyrene in acetone for a lifetime did not produce skin tumors in mice (Habs et al., 1980).

Rice et al. (1986) evaluated the tumor-initiating activity of indeno[1,2,3-*cd*]pyrene by applying indeno[1,2,3-*cd*]pyrene in acetone every other day for 10 days (total dose 1 mg) to the skin of 20 Crl:CD-1 mice. This procedure was followed by treatment with 12-*o*-tetradecanoyl-phorbol-13-acetate (TPA), 3 times weekly for 20 weeks. The incidence of skin tumors was close to 100%. Hoffmann and Wynder (1966) reported that 10 skin applications at two-day intervals at a total dose of 250  $\mu\text{g}$  initiated skin carcinogenesis when female Swiss albino mice were subsequently treated with croton oil. A total of 10 papillomas developed in five animals treated with croton oil.

Female Osborne-Mendel rats (35/group) received single lung implants of 0.16, 0.83, or 4.15 mg indeno[1,2,3-*cd*]pyrene in a mixture of beeswax and trioctanoin (Deutsch-Wenzel et al., 1983). An untreated group and a group receiving the vehicle served as controls. Granulomatous inflammatory lesions developed at the injection sites. After a lifetime of observation, the incidence of epidermoid carcinomas in the lung showed a statistically significant ( $p=0.05$ ) dose-related increase. The observed incidences were 3/35, 8/35, and 21/35, respectively, in the low-, mid-, and high-dose groups. In addition, one pleomorphic lung sarcoma developed in one low-dose rat. No lung tumors occurred in untreated or vehicle control animals.

Male and female XVII nc/Z mice (14/sex) were given s.c. injections of 0.6 mg indeno[1,2,3-*cd*]pyrene in olive oil once a month for 3 months (Lacassagne et al., 1963). Injection site sarcomas developed in ten male mice within 265 days and in one female mouse within 145 days. Although no concurrent controls were used, the authors reported that no spontaneous skin tumors had been observed in historical controls.

LaVoie et al. (1987) administered i.p. injections of indeno[1,2,3-*cd*]pyrene in dimethyl sulfoxide to 30 CD-1 mice (males and females combined) on days 1, 8, and 15 of life at a total dose of 2.1  $\mu\text{mol}$ /mouse. The animals were sacrificed at 52 weeks of age. A lung adenoma developed in 1/11 surviving male mice; no lung tumors were seen in female treated mice or in vehicle controls.

Although several noncarcinogenic PAHs have been shown to reduce the ability of benzo[*a*]pyrene to produce injection site sarcomas, s.c. injections of indeno[1,2,3-*cd*]pyrene in tricaprylin vehicle had no such inhibiting effect (Falk et al., 1964).

#### 4.4. EPA WEIGHT-OF-EVIDENCE

Classification -- B2; probable human carcinogen (U.S. EPA, 1994)

Basis -- Based on no human data and sufficient data from animal bioassays. Indeno[1,2,3-*cd*]pyrene produced tumors in mice after lung implants, s.c. injection, and dermal exposure. Indeno[1,2,3-*cd*]pyrene tested positive in bacterial gene mutation assays.

#### 4.5. CARCINOGENICITY SLOPE FACTORS

None were calculated.



## 5. REFERENCES

ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,i,h)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-c,d)pyrene, Phenanthrene, Pyrene. Prepared by Clement International Corporation, under Contract No. 205-88-0608. ATSDR/TP-90-20.

Deutsch-Wenzel, R.P., H. Brune, G. Grimmer, et al. 1983. Experimental studies in rat lungs on the carcinogenicity and dose-response relationships of eight frequently occurring environmental polycyclic aromatic hydrocarbons. *J. Natl. Cancer Inst.* 71: 539-544.

Falk, H.L., P. Kotin and S. Thompson. 1964. Inhibition of carcinogenesis. The effect of polycyclic hydrocarbons and related compounds. *Arch. Environ. Health* 9: 169-179.

Habs, M., D. Schmahl and J. Misfeld. 1980. Local carcinogenicity of some environmentally relevant polycyclic aromatic hydrocarbons after lifelong topical application to mouse skin. *Arch. Geschwulstforsch.* 50: 266-274. (Cited in ATSDR, 1990)

Hoffmann, D. and E.L. Wynder. 1966. Beitrag zur carcinogen Wirkung von Dibenzopyrene. *Z. Krebsforsch.* 68: 137-149. (Cited in U.S. EPA, 1988, 1991)

IARC (International Agency for Research on Cancer). 1973. Indeno(1,2,3-cd)pyrene. In: IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man. Certain Polycyclic Aromatic Hydrocarbons and Heterocyclic Compounds, Vol 3. IARC, Lyon, France, pp. 229-237.  
IARC (International Agency for Research on Cancer). 1983. Indeno[1,2,3-cd]pyrene. In: IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans. Polycyclic Aromatic Compounds, Part 1, Chemical, Environmental and Experimental Data, Vol 32. IARC, Lyon, France, pp. 373-378.

Lacassagne, A., N.P. Buu-Hoi, F. Zajdela, et al. 1963. Activite cancerogene d'hydrocarbures aromatiques polycycliques a noyau fluoranthene. *Un. Int. Cancer Acta* 19: 490-496. (French; cited in IARC, 1973; U.S. EPA, 1993)

LaVoie, E.J., J. Braley, J.E. Rice and A. Rivenson. 1987. Tumorigenic activity for non-alternant polynuclear aromatic hydrocarbons in newborn mice. *Cancer Lett.* 34: 15-20.

Rice, J.E., D.T. Coleman, T.J. Hosted, Jr., et al. 1985. Identification of mutagenic metabolites of indeno[1,2,3-cd]pyrene formed *in vitro* with rat liver enzymes. *Cancer Res.* 45: 5421-5425.

Rice, J.E., T.J. Hosted, Jr., M.C. DeFloria, et al. 1986. Tumor-initiating activity of major *in vivo* metabolites of indeno[1,2,3-cd]pyrene on mouse skin. *Carcinogenesis* 7: 1761-1764.

U.S. EPA (U.S. Environmental Protection Agency). 1991. Drinking Water Criteria Document for Polycyclic Aromatic Hydrocarbons (PAH). Prepared by the Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, U.S. Environmental Protection Agency, Cincinnati, OH, for the Office of Drinking Water. ECAO-CIN-D010.

U.S. EPA (U.S. Environmental Protection Agency). 1994. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH.

**TOXICITY SUMMARY  
for  
INORGANIC ARSENIC**

April 1992

Prepared by:

Dennis M. Opresko, Ph.D.

Chemical Hazard Evaluation and Communication Group  
Biomedical and Environmental Information Analysis Section  
Health and Safety Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for:

U.S. ARMY TOXIC AND  
HAZARDOUS MATERIALS AGENCY  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Environmental Branch, Technology Division  
U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY  
Aberdeen Proving Ground, Maryland 21010-5401

---

\*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400

## EXECUTIVE SUMMARY

The toxicity of inorganic arsenic (As) depends on its valence state (-3, +3, or +5), and also on the physical and chemical properties of the compound in which it occurs. Trivalent ( $\text{As}^{+3}$ ) compounds are generally more toxic than pentavalent ( $\text{As}^{+5}$ ) compounds, and the more water soluble compounds are usually more toxic and more likely to have systemic effects than the less soluble compounds, which are more likely to cause chronic pulmonary effects if inhaled. One of the most toxic inorganic arsenic compounds is arsine gas ( $\text{AsH}_3$ ). It should be noted that laboratory animals are generally less sensitive than humans to the toxic effects of inorganic arsenic. In addition, in rodents the critical effects appear to be immunosuppression and hepato-renal dysfunction, whereas in humans the skin, vascular system, and peripheral nervous system are the primary target organs.

Water soluble inorganic arsenic compounds are absorbed through the G.I. tract (>90%) and lungs; distributed primarily to the liver, kidney, lung, spleen, aorta, and skin; and excreted mainly in the urine at rates as high as 80% in 61 hr following oral dosing (U.S. EPA, 1984; ATSDR, 1989; Crecelius, 1977). Pentavalent arsenic is reduced to the trivalent form and then methylated in the liver to less toxic methylarsinic acids (ATSDR, 1989).

Symptoms of acute inorganic arsenic poisoning in humans are nausea, anorexia, vomiting, epigastric and abdominal pain, and diarrhea. Dermatitis (exfoliative erythroderma), muscle cramps, cardiac abnormalities, hepatotoxicity, bone marrow suppression and hematologic abnormalities (anemia), vascular lesions, and peripheral neuropathy (motor dysfunction, paresthesia) have also been reported (U.S. Air Force, 1990; ATSDR, 1989; Franzblau and Lilis, 1989; U.S. EPA, 1984; Armstrong et al., 1984; Hayes, 1982; Mizuta et al., 1956). Oral doses as low as 20-60  $\mu\text{g}/\text{kg}/\text{day}$  have been reported to cause toxic effects in some individuals (ATSDR, 1989). Severe exposures can result in acute encephalopathy, congestive heart failure, stupor, convulsions, paralysis, coma, and death. The acute lethal dose to humans has been estimated to be about 0.6  $\text{mg}/\text{kg}/\text{day}$  (ATSDR, 1989). General symptoms of chronic arsenic poisoning in humans are weakness, general debility and lassitude, loss of appetite and energy, loss of hair, hoarseness of voice, loss of weight, and mental disorders (Hindmarsh and McCurdy, 1986). Primary target organs are the skin (hyperpigmentation and hyperkeratosis) [Terada et al. 1960; Tseng et al., 1968; Zaldivar 1974; Cebrian et al., 1983; Huang et al., 1985], nervous system (peripheral neuropathy) [Hindmarsh et al., 1977, 1986; Valentine et al., 1982; Heyman et al., 1956; Mizuta et al., 1956; Tay and Seah, 1975], and vascular system [Tseng et al., 1968; Borgano and Greiber, 1972; Salcedo et al., 1984; Wu et al., 1989; Hansen, 1990]. Anemia, leukopenia, hepatomegaly, and portal hypertension have also been reported (Terada et al., 1960; Viallet et al., 1972; Morris et al., 1974; Datta, 1976). In addition, possible reproductive effects include a high male to female birth ratio (Lyster, 1977).

In animals, acute oral exposures can cause gastrointestinal and neurological effects (Heywood and Sortwell, 1979). Oral  $\text{LD}_{50}$  values range from about 10 to 300  $\text{mg}/\text{kg}$  (ASTDR, 1989; U.S. Air Force, 1990). Low subchronic doses can result in immunosuppression, (Blakely et al., 1980) and hepato-renal effects (Mahaffey et al., 1981; Brown et al., 1976; Woods and Fowler, 1977, 1978; Fowler and Woods, 1979; Fowler et al., 1979). Chronic exposures have also resulted in mild hyperkeratosis and bile duct enlargement with hyperplasia, focal necrosis, and fibrosis (Baroni et al., 1963; Byron et al., 1967). Reduction in litter size, high male/female birth ratios, and fetotoxicity without significant fetal abnormalities occur following oral exposures (Schroeder and Mitchener, 1971; Hood et al., 1977; Baxley et al., 1981); however, parenteral dosing has resulted in exencephaly, encephaloceles, skeletal defects, and urogenital system abnormalities (Ferm and Carpenter, 1968; Hood and Bishop, 1972; Beaudoin, 1974; Burk and Beandoin, 1977).

The Reference Dose for chronic oral exposures, 0.0003  $\text{mg}/\text{kg}/\text{day}$ , is based on a NOAEL of 0.0008  $\text{mg}/\text{kg}/\text{day}$  and a LOAEL of 0.014  $\text{mg}/\text{kg}/\text{day}$  for hyperpigmentation, keratosis, and possible vascular complications in a human population consuming arsenic-contaminated drinking water (U.S. EPA, 1991a).

Because of uncertainties in the data, U.S. EPA (1991a) states that "strong scientific arguments can be made for various values within a factor of 2 or 3 of the currently recommended RfD value." The subchronic Reference Dose is the same as the chronic RfD, 0.0003 mg/kg/day (U.S. EPA, 1992).

Acute inhalation exposures to inorganic arsenic can damage mucous membranes, cause rhinitis, pharyngitis and laryngitis, and result in nasal septum perforation (U.S. EPA, 1984). Chronic inhalation exposures, as occurring in the workplace, can lead to rhino-pharyno-laryngitis, tracheobronchitis, (Lundgren, 1954); dermatitis, hyperpigmentation, and hyperkeratosis (Perry et al., 1948; Pinto and McGill, 1955); leukopenia (Kyle and Pease, 1965; Hine et al., 1977); peripheral nerve dysfunction as indicated by abnormal nerve conduction velocities (Feldman et al., 1979; Blom et al., 1985; Landau et al., 1977); and peripheral vascular disorders as indicated by Raynaud's syndrome and increased vasospastic reactivity in fingers exposed to low temperatures (Lagerkvist et al., 1986). Higher rates of cardiovascular disease have also been reported in some arsenic-exposed workers (Lee and Fraumeni, 1969; Axelson et al., 1978; Wingren and Axelson, 1985). Possible reproductive effects include a high frequency of spontaneous abortions and reduced birth weights (Nordström et al., 1978a,b). Arsine gas ( $\text{AsH}_3$ ), at concentrations as low as 3-10 ppm for several hours, can cause toxic effects. Hemolysis, hemoglobinuria, jaundice, hemolytic anemia, and necrosis of the renal tubules have been reported in exposed workers (ACGIH, 1986; Fowler and Weissberg, 1974).

Animal studies have shown that inorganic arsenic, by intratracheal instillation, can cause pulmonary inflammation and hyperplasia (Webb et al., 1986, 1987), lung lesions (Pershagen et al., 1982), and immunosuppression (Hatch et al. (1985). Long-term inhalation exposures have resulted in altered conditioned reflexes and CNS damage (Rozenshtein, 1970). Reductions in fetal weight and in the number of live fetuses, and increases in fetal abnormalities due to retarded osteogenesis have been observed following inhalation exposures (Nagymajtenyi et al., 1985).

Subchronic and chronic RfCs for inorganic arsenic have not been derived.

Epidemiological studies have revealed an association between arsenic concentrations in drinking water and increased incidences of skin cancers (including squamous cell carcinomas and multiple basal cell carcinomas), as well as cancers of the liver, bladder, respiratory and gastrointestinal tracts (U.S. EPA, 1987; IARC, 1987; Sommers et al., 1953; Reymann et al., 1978; Dobson et al., 1965; Chen et al., 1985, 1986). Occupational exposure studies have shown a clear correlation between exposure to arsenic and lung cancer mortality (IARC, 1987; U.S. EPA, 1991a). U.S. EPA (1991a) has placed inorganic arsenic in weight-of-evidence group A, human carcinogen. A drinking water unit risk of  $5\text{E-}5(\mu\text{g/L})^{-1}$  has been proposed (U.S. EPA, 1991a); derived from drinking water unit risks for females and males that are equivalent to slope factors of  $1.0\text{E-}3(\mu\text{g/kg/day})^{-1}$  (females) and  $2.0\text{E-}3(\mu\text{g/kg/day})^{-1}$  (males) (U.S. EPA, 1987). For inhalation exposures, a unit risk of  $4.3\text{E-}3(\mu\text{g/m}^3)^{-1}$  (U.S. EPA, 1991a) and a slope factor of  $5.0\text{E+}1(\text{mg/kg/day})^{-1}$  have been derived (U.S. EPA, 1992).

## 1. INTRODUCTION

The toxicity of inorganic compounds containing arsenic depends on the valence or oxidation state of the arsenic (-3, +3, or +5), as well as on the physical and chemical properties of the compound in which it occurs. Trivalent ( $\text{As}^{+3}$ ) compounds such as arsenic trioxide ( $\text{As}_2\text{O}_3$ ), arsenic trisulfide ( $\text{As}_2\text{S}_3$ ), and sodium arsenite ( $\text{NaAsO}_2$ ), are generally more toxic than pentavalent ( $\text{As}^{+5}$ ) compounds such as arsenic pentoxide ( $\text{As}_2\text{O}_5$ ), sodium arsenate ( $\text{Na}_2\text{HAsO}_4$ ), and calcium arsenate ( $\text{Ca}_3(\text{AsO}_4)_2$ ). Trivalent arsenic interacts with sulfhydryl groups of proteins and enzymes; pentavalent arsenic substitutes for phosphate groups important in oxidative phosphorylation (Squibb and Fowler, 1983). The relative toxicity of the trivalent and pentavalent forms may also be affected by factors such as the water solubility of the compound. Although the more water soluble arsenic compounds are generally more toxic and more likely to have systemic effects, the less soluble compounds are more likely to cause chronic pulmonary effects if inhaled. One of the most toxic arsenic compounds is arsine gas ( $\text{AsH}_3$ ) with arsenic in the -3 valence state.

It should be noted that laboratory animals are generally less sensitive than humans to the toxic effects of inorganic arsenic. In addition, in rodents the critical effects appear to be immunosuppression and hepatorenal dysfunction, whereas in humans the skin, vascular system, and peripheral nervous system are the primary target organs.

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

Absorption of water soluble inorganic arsenic compounds through the G.I. tract is very high. In humans, absorption rates of 96.5% for trivalent sodium arsenite and 94% for soluble pentavalent arsenic have been reported (Bettley and O'Shea, 1975; Pomroy et al., 1980). In contrast, G.I. absorption of the less soluble arsenic trisulfide and lead arsenate was reported to be only 20-30% in hamsters (Marafante and Vahter, 1987). In tests on humans, absorption of the insoluble arsenic selenide appeared to be negligible as indicated by the absence of an increase in urinary arsenic excretion (Mappes, 1977).

Absorption of arsenic in the lungs is dependant on particle size as well as water solubility; respirable particles ( $0.1-1\ \mu$ ) are carried further into the lungs and are therefore more likely to be absorbed (ATSDR, 1989). Estimates of pulmonary absorption may be complicated by the fact that some of the particles may be cleared from the lungs, then swallowed and absorbed through the G.I. tract. In studies on smelter workers exposed to arsenic dusts of about  $5\ \mu$  particle size, Lagerkvist et al. (1986) estimated that 75% of the dust would be deposited in the respiratory tract and 80% of this would be absorbed directly or through the stomach after mucociliary clearance.

### 2.2. DISTRIBUTION

Following absorption of trivalent or pentavalent arsenic compounds, arsenic is initially accumulated in the liver, kidney, lung, spleen, aorta, and skin. With the exception of the skin, clearance from these organs is rapid. Arsenic is also extensively deposited in the hair and nails (U.S. EPA, 1984).

### 2.3. METABOLISM

Arsenic compounds are subject to metabolic transformation. In both humans and animals, pentavalent arsenic compounds are reduced to trivalent forms and then methylated in the liver to less toxic methylarsinic acids (ATSDR, 1989).

## **2.4. EXCRETION**

Arsenic is cleared from the body relatively rapidly and primarily in the urine. Urinary excretion rates of 80% in 61 hr following oral doses and 30-80% in 4-5 days following parenteral doses have been measured in humans (Crecelius, 1977; Hunter et al., 1942). Arsenic is also lost from the body in the hair and nails, since this represents a non-biologically available arsenic pool.

## **3. NONCARCINOGENIC HEALTH EFFECTS**

### **3.1. ORAL EXPOSURES**

#### **3.1.1. Acute Toxicity**

##### **3.1.1.1. Human**

Common symptoms of inorganic arsenic poisoning are nausea, anorexia, vomiting, epigastric and abdominal pain, and diarrhea. Dermatitis (exfoliative erythroderma), muscle cramps, cardiac abnormalities, hepatotoxicity, bone marrow suppression and hematologic abnormalities (anemia and leukopenia), vascular lesions, and peripheral neuropathy (motor dysfunction, long axon Wallerian degeneration) have also been reported (U.S. Air Force, 1990; ATSDR, 1989; Franzblau and Lilis, 1989; U.S. EPA, 1984; Armstrong et al., 1984; Hayes, 1982; Mizuta et al., 1956).

Oral doses as low as 20-60 µg/kg/day have been reported to cause toxic effects in some individuals (ATSDR, 1989). Severe exposures can result in acute encephalopathy, congestive heart failure, stupor, convulsions, paralysis, coma, and death. The acute lethal dose to humans has been estimated to be about 0.6 mg/kg/day (ATSDR, 1989). A dose estimated at 3 mg/day for a 1-2 month period was fatal to 1% of a group of infants receiving arsenic-contaminated milk (Hamamoto, 1955).

##### **3.1.1.2. Animal**

Monkeys exposed to acutely toxic doses of inorganic arsenic exhibit gastrointestinal distress and neurological effects. Adolescent and infant Rhesus monkeys receiving 5 daily oral doses of a complex inorganic arsenic compound containing the equivalent of 7.5 mg/kg of arsenic trioxide exhibited loss of condition, vomiting, diarrhea, salivation and uncontrolled shaking of the head (Heywood and Sortwell, 1979).

LD<sub>50</sub> values for inorganic arsenic compounds in laboratory animals range from about 10 to 300 mg/kg (ASTDR, 1989; U.S. Air Force, 1990).

#### **3.1.2. Subchronic Toxicity**

##### **3.1.2.1. Human**

Depending on the dose and duration, subchronic exposures to inorganic arsenic can cause toxic effects similar to those caused by acute and/or chronic exposures. Skin and vascular disorders, neuropathy, gastroenteritis, hepatotoxicity, and hematological abnormalities (anemia and leukopenia) have been reported in individuals exposed for time periods ranging from less than 6 months to 13 years (ATSDR, 1989; Huang et al., 1985).

Borgono and Greiber (1972) reported a 12% incidence of skin abnormalities in children whose drinking water contained 0.6-0.8 mg As/L. The earliest cases occurred about 4-5 years after the initial exposure. Cardiovascular effects, including Raynaud's syndrome, acrocyanosis, angina pectoris,

hypertension, myocardial infarction, mesenteric thrombosis, systemic occlusive arterial disease, bronchiectasis, and recurrent broncho-pneumonia were also observed in this group of subjects (Zaldivar, 1980). The bronchiectasis and recurrent broncho-pneumonia were attributed to an immunosuppressive action of arsenic in the lungs. A significant decrease in the incidence of skin abnormalities was observed following a reduction in drinking water concentration to about 0.04 mg/L. After 4 years at the lower exposure, effects were rarely seen in children younger than 12 years old (Borgono et al., 1977).

Central nervous system deficits (hearing loss, eye damage, abnormal EEGs, mental retardation, epilepsy), electrocardiographic changes (elevated ST wave and extended QT interval), and skin abnormalities (melanosis, desquamation, rashes, and hyperkeratosis) occurred in infants who had been fed arsenic-contaminated milk for 1-2 months (Hamamoto, 1955). It was estimated that the daily arsenic intake was about 3 mg/day (U.S. EPA, 1984).

### **3.1.2.2. Animal**

Immunosuppression and hepato-renal toxicity have been identified as toxic effects in rodents. Immunosuppression, as measured by hemagglutination, radial immunodiffusion, and Cunningham plaque assays, was observed in mice exposed for 3 weeks to sodium arsenite levels of 0.5 ppm in drinking water (Blakely et al., 1980). Reported hepato-renal effects include: (1) mild swelling of renal tubular cell mitochondria and decreases in liver-derived serum enzymes (aspartate aminotransferase [AST] and alkaline phosphatase) in rats following 10 weeks exposure to 50 ppm dietary arsenate (Mahaffey et al., 1981); (2) functional and ultrastructural changes in the kidneys of rats exposed for 6 weeks to arsenate concentrations of 85 and 125 ppm in drinking water (Brown et al., 1976); (3) disruption of liver biosynthesis of heme and  $\delta$ -aminolevulinic (ALA) synthetase activity in mice and rats exposed for 6 wk to 40 and 85 ppm arsenic in drinking water (Woods and Fowler, 1977, 1978); (4) alteration of hepatocyte mitochondrial structure and liver enzyme activity (monoamine oxidase, cytochrome oxidase) in rats and mice exposed for 6 weeks to 20-85 ppm sodium arsenate in drinking water (Fowler and Woods, 1979; Fowler et al., 1979); and (5) increases in serum AST and alanine aminotransferase (ALT) levels due to hepatocyte plasma membrane dysfunction in beagle dogs fed dietary levels of sodium arsenite equivalent to 4 mg/kg for 58 days followed by 8 mg/kg/day for an additional 125 days (Neiger and Osweiler, 1989).

In a six-month study in which rats were fed 250 ppm pentavalent or trivalent arsenic, Douglas and Blendermann (1961) found that trivalent arsenic caused bile duct lesions and a significant depression in growth.

Although arsenic-induced skin disorders are not commonly seen in rodents, eczema, hyperplasia, and hyperkeratosis were reported in two-week-old rats dosed for 40 days by stomach intubation with 2 mg/kg/day or 10 mg/kg/day of arsenic trioxide (Ishinishi et al., 1976). Avoidance conditioning responses were also impaired by these dose levels (Osato, 1977).

### **3.1.3. Chronic Toxicity**

#### **3.1.3.1. Human**

General symptoms of chronic arsenic poisoning are weakness, general debility and lassitude, loss of appetite and energy, loss of hair, hoarseness of the voice, loss of weight, and mental abnormalities (Hindmarsh and McCurdy, 1986). Skin, neurological, and vascular disorders are the most common effects seen following long-term exposures.

Skin abnormalities, particularly hyperpigmentation and hyperkeratosis have been observed in populations exposed to arsenic in drinking water (Terada et al. 1960; Tseng et al., 1968; Zaldivar 1974; Cebrian et al., 1983; Huang et al., 1985). Tseng et al. (1968) reported an incidence rate of 18% for

hyperpigmentation and 7% for hyperkeratosis in a Taiwanese population whose drinking water contained an average arsenic concentration of 0.4-0.6 ppm. Skin abnormalities were also reported in 40% of patients consuming Fowler's solution for 6-26 years (Fierz, 1965).

Arsenic-induced neurotoxicity is manifested as a peripheral neuropathy involving both sensory and motor nerves, and resulting in numbness and paresthesia, diminished sensations of touch, pain, heat, and cold, and muscle weakness (Hindmarsh et al., 1977; Hindmarsh and McCurdy, 1986; Valentine et al., 1982; Heyman et al., 1956; Mizuta et al., 1956; Tay and Seah, 1975).

Peripheral vascular disorders have been reported in several populations whose drinking water contained high arsenic levels (Tseng et al., 1968; Salcedo et al., 1984; Chen et al., 1988). Blackfoot disease (a condition caused by arteriosclerosis and thromboangiitis obliterans), which can result in gangrene of the lower extremities, occurred in 0.9% of one such population (Tseng et al., 1968; 1977). Epidemiological studies and mechanistic considerations have implicated arsenic as a possible causative factor in arteriosclerotic plaque formation and cardiovascular disease (Wu et al., 1989; Hansen, 1990; Penn, 1990).

Chronic oral exposures to arsenic reportedly have also resulted in anemia, leukopenia, liver swelling, and noncirrhotic portal hypertension (Terada et al., 1960; Viallet et al., 1972; Morris et al., 1974; Datta, 1976; Nevens et al., 1990).

#### **3.1.3.2. Animal**

Studies in rats have demonstrated no-adverse-effect levels of 1.4 (males) and 1.6 mg As/kg/day (females) for sodium arsenite and 2.8 (males) and 3.25 mg As/kg/day (females) for sodium arsenate (Byron et al., 1967). Similar studies on dogs revealed a no-adverse-effect level at 1.1 mg As/kg/day. A drinking water concentration of 5 ppm produced no toxic effects in rats when administered over an entire lifetime (Schroeder et al., 1968).

Mild hyperkeratosis has been reported in mice exposed for a lifetime to arsenic oxide in drinking water at a concentration of 0.01% (Baroni et al., 1963).

Bile duct enlargement with hyperplasia of the glandular elements, focal necrosis, and fibrosis was seen in rats receiving dietary arsenic levels of 125 and 250 ppm as sodium arsenite and 250 and 400 ppm as sodium arsenate for up to two years (Byron et al., 1967). Lifetime (29 mo) exposure to lead arsenate at a dietary level of 1850 ppm also caused bile duct lesions in rats (Kroes et al., 1974).

#### **3.1.4. Developmental and Reproductive Toxicity**

##### **3.1.4.1. Human**

A high male-to-female birth ratio (157 to 100) was reported for a population that may have been exposed to elevated arsenic levels in their drinking water 10 to 11 months earlier (Lyster, 1977).

##### **3.1.4.2. Animal**

Chronic exposure of pregnant mice to 5 ppm sodium arsenite in drinking water resulted in a slight reduction in litter size and a higher male/female ratio (increased from 0.93 to 1.71), but no adverse effects on fetal development (Schroeder and Mitchner, 1971). Oral doses as high as 120 mg/kg/day of sodium arsenate were reported to be fetotoxic but not teratogenic to rats (Hood et al., 1977). Oral doses of 25-40 mg/kg of sodium arsenite caused prenatal mortality and a low, but non-significant, incidence of fetal malformations (exencephaly) in mice (Baxley et al., 1981).



### **3.1.5. Reference Dose**

#### **3.1.5.1. Subchronic**

ORAL RfD: 0.0003 mg/kg/day (U.S. EPA, 1992)  
UNCERTAINTY FACTOR: 3  
NOAEL: 0.0008 mg/kg/day, epidemiological study.

COMMENT: The same study applies to the subchronic and chronic RfD (see Section 3.1.5.2).

#### **3.1.5.2. Chronic**

ORAL RfD: 0.0003 mg/kg/day (U.S. EPA, 1991a)  
UNCERTAINTY FACTOR: 3  
MODIFYING FACTOR: 1  
NOAEL: 0.0008 mg/kg/day, epidemiological study  
CONFIDENCE:

Study: Medium  
Data Base: Medium  
RfD: Medium

VERIFICATION DATE: 11/15/90

PRINCIPAL STUDIES: Tseng, W.P. 1977; Tseng et al., 1968

COMMENT: The NOAEL was based on an arithmetic mean of 0.009 mg/L in drinking water (range 0.001-0.17 mg/L), a daily water consumption of 4.5 L, and an arsenic intake in food of 0.002 mg/day. A LOAEL of 0.014 mg/kg/day for hyperpigmentation, keratosis, and possible vascular complications, was based on an arithmetic mean of 0.14 mg/L in drinking water (4.5 L/day), and 0.002 mg/kg in food. The UF of 3 is to account for both the lack of data to preclude reproductive toxicity as a critical effect and to account for some uncertainty in whether the NOAEL of the critical study accounts for all sensitive individuals.

NOTE: U.S. EPA (1991a) states that "strong scientific arguments can be made for various values within a factor of 2 or 3 of the currently recommended RfD value, i.e., 0.1-0.8  $\mu\text{g/kg/day}$ "; therefore, considerable flexibility is allowed in formulating regulatory decisions.

### **3.2. INHALATION EXPOSURES**

#### **3.2.1. Acute Toxicity**

##### **3.2.1.1. Human**

Inorganic arsenic dusts can cause respiratory irritation and mucous membrane damage leading to rhinitis, pharyngitis or laryngitis. Several weeks exposure to high concentrations can result in nasal septum perforation (U.S. EPA, 1984). Although inhalation exposures to most inorganic arsenic compounds are not usually associated with acute lethality (ATSDR, 1989); exposure to 250 ppm of arsine gas is instantly fatal and several hours exposure to concentrations as low as 10 ppm can produce toxic symptoms and may also be fatal (Fowler and Weissberg, 1974; NIOSH, 1979). Arsine causes severe hemolysis, hemoglobinuria, jaundice, hemolytic anemia, and necrosis of the renal tubules (ACGIH, 1986; Fowler and Weissberg, 1974).

##### **3.2.1.2. Animal**

Intratracheal instillation studies indicate that inorganic arsenic can have direct toxic effects on respiratory tissue. Trivalent arsenic oxide and gallium arsenide were shown to cause pulmonary inflammation and hyperplasia in rats (Webb et al., 1986, 1987), and calcium arsenate caused lung lesions in hamsters; however, arsenic trioxide and arsenic trisulfide did not have such an effect (Pershagen et al., 1982).

The pulmonary immune response can be affected by inorganic arsenic compounds. Hatch et al. (1985) reported significant increases in mortality of mice due to infectious streptococcal challenge following intratracheal injection of sodium arsenite, and Aranyi et al. (1985) reported similar increases in mortality as well as decreases in pulmonary bactericidal activity to *Klebsiella pneumonia* following single and multiple inhalation exposures to arsenic trioxide.

Exposure of mice to arsine concentrations as low as 2.5 ppm caused significant decreases in red blood cells, hematocrit and hemoglobin, as well as significant increases in white blood cell counts, and mean corpuscular volume of RBC. Erythropoiesis in bone marrow cells was impaired and erythropoiesis in the spleen was increased (Hong et al., 1989).

### **3.2.2. Subchronic Toxicity**

#### **3.2.2.1. Human**

Subchronic inhalation exposures to inorganic arsenic are expected to cause toxic effects similar to those resulting from chronic exposures (see Section 3.2.3).

#### **3.2.2.2. Animal**

Rats exposed for 3 months to 46  $\mu\text{g}/\text{m}^3$  of arsenic trioxide aerosol exhibited altered conditioned reflexes and CNS damage as evidenced by pericellular edema and neuronal cytolysis in the brain (Rozenshtein, 1970).

Rats exposed to 0.025 ppm arsine gas for 90 days developed anemia (Blair et al., 1990). Higher exposure levels (primarily 2.5 ppm) resulted in bone marrow hyperplasia, increased splenic hemosiderosis and extramedullary hematopoiesis, decreased packed cell volume, increased delta-aminolevulinic acid dehydratase activity, and increased relative spleen weight. Similar effects were seen in mice and hamsters.

### **3.2.3. Chronic Toxicity**

#### **3.2.3.1. Human**

Information on the inhalation toxicity of inorganic arsenic is derived primarily from occupational exposure studies, particularly those involving smelter workers. Early studies identified chronic respiratory diseases (rhinitis, pharyngitis, laryngitis, tracheobronchitis, and pulmonary insufficiency) and blood disorders (leukopenia) in exposed workers (Lundgren, 1954; Kyle and Pease, 1965). In one study, a 23% incidence of relative neutropenia occurred in 130 smelter workers exposed to arsenic air concentrations averaging less than 0.5  $\text{mg}/\text{m}^3$  (Hine et al., 1977).

Neurological disorders (peripheral nerve dysfunction indicated by abnormal nerve conduction velocities) have been documented in smelter workers exposed to arsenic concentrations of  $\leq 0.5 \text{ mg}/\text{m}^3$  (Feldman et al., 1979; Blom et al., 1985; Landau et al., 1977). Chronic encephalopathy, evidenced by cognitive impairment and psychological symptoms was reported in two workers exposed to arsenic fumes for 14-18 months (Morton and Caron, 1989). Abnormal electromyograms were reported for populations living near an arsenic mine and smelter (Takahashi, 1974). Hearing losses have been reported in children living near a coal-fired power plant burning high-arsenic content coal (U.S. EPA, 1984).

Chronic exposure of smelter workers to low levels of atmospheric arsenic ( $\leq 0.5 \text{ mg/m}^3$ ) caused subtle changes in the peripheral vascular system, as indicated by an increased incidence of Raynaud's syndrome (white fingers) and increased vasospastic reactivity in fingers exposed to low temperatures (Lagerkvist et al., 1986). Higher rates of cardiovascular disease have also been reported in some arsenic-exposed workers (Lee and Fraumeni, 1969; Axelson et al., 1978; Wingren and Axelson, 1985).

Dermatitis, hyperpigmentation, and hyperkeratosis were observed in early studies of workers exposed to inorganic arsenic (Perry et al., 1948; Pinto and McGill, 1953); however, it is not known to what degree the reported effects were due to direct skin contact and accidental ingestion of the arsenic dust.

Chronic exposure to very low levels of arsine gas may have a cumulative effect in causing anemia (Fowler and Weissberg, 1974).

#### **3.2.3.2 Animal**

Glaser et al. (1986) exposed male Wistar rats to aerosols ( $<0.3 \text{ }\mu\text{m MMAD}$ ) of arsenic trioxide for 18 months at concentrations of 0, 60, and  $200 \text{ }\mu\text{g/m}^3$ . The animals were observed for one year after the termination of the exposures and no adverse effects on body weight, hematology, clinical chemistry, or macro- or microscopic structure of internal organs were reported.

#### **3.2.4. Developmental and Reproductive Toxicity**

##### **3.2.4.1. Human**

A significantly higher frequency of spontaneous abortions (11% vs 7.6%) and significantly reduced birth weights were recorded for a population living near a copper smelter when compared with control populations (Nordström et al., 1978a,b).

##### **3.2.4.2. Animal**

Nagymajtenyi et al. (1985) exposed mice for 4 hr/day to an aerosol of arsenic trioxide ( $28.5 \text{ mg/m}^3$ ) on days 9-12 of gestation, and found a significant reduction in fetal weight and in the number of live fetuses. In addition, there was a significant increase in the number of fetuses with retarded osteogenesis and an increase in the frequency of chromosomal aberrations (chromosome breaks and chromatid exchanges). Concentrations of  $2.9 \text{ mg/m}^3$  and  $0.26 \text{ mg/m}^3$  caused no significant changes, except a slight decrease in fetal weight.

#### **3.2.5. Reference Dose/Concentration**

Subchronic and chronic RfCs for inorganic arsenic have not been derived.

### **3.3. OTHER ROUTES OF EXPOSURE**

#### **3.3.1. Acute Toxicity**

##### **3.3.1.1. Human**

Information on the acute toxicity of inorganic arsenic to humans by other routes of exposure was not available.

##### **3.3.1.2. Animal**

Intraperitoneal LD<sub>50</sub> values of 4-20 mg/kg for various inorganic arsenic compounds have been reported (ATSDR, 1989).

### **3.3.2. Subchronic Toxicity**

#### **3.3.2.1. Human**

Information on the subchronic toxicity of inorganic arsenic to humans by other routes of exposure was not available.

#### **3.3.2.2. Animal**

Intraperitoneal injections of sodium arsenate solution at a dose level of 0.2 mg/kg for two months, resulted in inner ear damage and hearing loss in guinea pigs (Aly et al., 1975).

### **3.3.3. Chronic Toxicity**

#### **3.3.3.1. Human**

Skin contact with inorganic arsenic dusts in occupationally exposed workers has been associated with direct dermatitis, allergic hypersensitivity, and conjunctivitis (U.S. EPA, 1984; Pinto and McGill, 1953; Holmqvist, 1951).

#### **3.3.3.2. Animal**

Weekly injections of up to 10 mg/kg/day, for 18 months did not produce signs of neuropathy in rats (Schaumburg, 1980).

### **3.3.4. Developmental and Reproductive Toxicity**

#### **3.3.4.1. Human**

Information on the developmental and reproductive toxicity of inorganic arsenic to humans by other routes of exposure was not available.

#### **3.3.4.2. Animal**

Some inorganic arsenic compounds cause teratogenic effects when administered parenterally. Intravenous injections of sodium arsenate into hamsters on day 8 of gestation at dose levels of 15, 17.5, or 20 mg/kg/day resulted in exencephaly, encephaloceles, skeletal defects, and urogenital system abnormalities in fetuses (Ferm and Carpenter, 1968). Intraperitoneal injections of sodium arsenate, at doses levels of 30 mg/kg/day or higher, resulted in similar terata in rats and mice (Hood and Bishop, 1972; Beaudoin, 1974; Burk and Beaudoin, 1977).

## **3.4. TARGET ORGAN/CRITICAL EFFECTS**

### **3.4.1. Oral Exposures**

#### **3.4.1.1. Primary Target Organs**

1. Skin: Hyperpigmentation and hyperkeratosis in humans.

2. Nervous System: Peripheral neuropathy and CNS effects in humans.
3. Cardiovascular System: Peripheral and cardiovascular disorders in humans.

#### **3.4.1.2. Other Target Organs**

1. Blood: Hematological changes (anemia, leukopenia).
2. Liver: Liver swelling in humans; cirrhosis and portal hypertension in animals.
3. G.I. System: Gastroenteritis in humans and monkeys at high doses.
4. Reproductive Effects: Increased male to female birth ratio in animals and possibly in humans.

#### **3.4.2. Inhalation Exposures**

##### **3.4.2.1. Primary Target Organs**

1. Skin: Dermatitis and possibly hyperpigmentation and hyperkeratosis in humans.
2. Nervous System: Peripheral neuropathy and CNS effects in humans.
3. Cardiovascular System: Peripheral vascular disorders in humans.

##### **3.4.2.2. Other Target Organs**

1. Respiratory system: Rhinitis, laryngitis, tracheobronchitis, pulmonary insufficiency, emphysema.
2. Blood: Hematological changes (anemia, leukopenia).
3. Developmental Effects: Increase in spontaneous abortions, reduction in birth weight observed in animals and humans.

## **4. CARCINOGENICITY**

### **4.1. ORAL EXPOSURES**

#### **4.1.1. Human**

Epidemiological studies have revealed a close association between arsenic concentrations in drinking water and increased incidences of skin cancers, including squamous cell carcinomas and multiple basal cell carcinomas (U.S. EPA, 1987). Tseng et al. (1968) reported skin cancer rates of 2.6, 10.1 and 21.4 per 1000 in Taiwanese populations whose drinking water contained  $\leq 0.30$ , 0.30-0.59, and  $\geq 0.6$  ppm As, respectively. No cases of skin cancer were seen in a control population of 7500 whose drinking water contained 0.001-0.017 ppm As. Cebrian et al. (1983) reported a 3.6-fold increase in skin lesions thought to be associated with epidermoid or basal cell carcinomas, in residents of a Mexican town whose drinking water contained 0.4 ppm As.

Chronic oral exposure to arsenic has also been linked to various types of internal cancers, including those of the liver, bladder, and respiratory and gastrointestinal tracts (U.S. EPA, 1987; IARC, 1987; Sommers and McManus, 1953; Reymann et al., 1978; Dobson et al., 1965; Chen et al., 1985, 1986).

#### 4.1.2. Animal

Of the many studies conducted on laboratory animals, only a few have been able to show a positive association between oral exposure to arsenic and increased tumor incidence. Knoth (1966/67) reported increased incidences of adenocarcinomas of the skin, lung, peritoneum, and lymph nodes in NMRI mice dosed with arsenic trioxide or Fowler's solution once per week for 5 months (estimated total dose 7 mg/animal). Katsnelson et al. (1986) reported that arsenic trioxide induced a low incidence of adenocarcinomas at the site of its implantation in the stomach of rats. In addition, Shirachi et al. (1983) reported that sodium arsenite enhanced the incidence of renal tumors induced in rats by intraperitoneal injection of the carcinogen *N*-nitrosodiethylamine.

### 4.2. INHALATION EXPOSURES

#### 4.2.1. Human

Occupational exposure studies of smelter and pesticide workers have shown a close association between exposure to arsenic and lung cancer mortality (IARC, 1987; U.S. EPA, 1991a). A dose- and duration-dependent increased frequency of respiratory tract cancers was found in copper smelter workers exposed to air-borne arsenic concentrations averaging up to 62 mg/m<sup>3</sup> (arithmetic mean) (Lee and Fraumeni, 1969; Lee-Feldstein, 1983, 1986, 1989). Standardized mortality ratios (SMR) as high as 981 and a maximum relative risk of 6 were reported (Lee-Feldstein, 1986, 1989). At another smelter, lung cancer mortality rates were correlated with cumulative arsenic exposure as measured by urinary arsenic excretion values, and arsenic concentrations of 10 mg/m<sup>3</sup> were linked to a SMR greater than 200 (Enterline and Marsh, 1982; Enterline et al., 1987). Similarly, in a study of Swedish smelter workers, a clear positive dose-response relationship was found between cumulative arsenic exposure and lung cancer mortality and the overall SMR was 372 (Järup et al., 1989). Both proportionate mortality and cohort studies of pesticide workers have also shown an increased incidence of lung cancer deaths (Ott et al., 1974; Mabuchi et al., 1979).

An increased risk of lung cancer may also occur in non-occupationally exposed populations living in areas with high atmospheric levels of arsenic resulting from industrial emissions. Higher lung cancer rates have been reported in residents living near smelters (Brown et al., 1984; Pershagen 1985) and near an arsenic pesticide manufacturing plant (Matanoski et al., 1981).

#### 4.2.2. Animal

Several animal studies have shown an association between tumor induction and exposure to arsenic by inhalation or intratracheal instillation. Ivankovic et al. (1979) reported that lung tumors developed in 9 of 15 BD IX rats given a single intratracheal instillation of Bordeaux mixture (4% calcium arsenate containing 0.07 mg As). In another study, calcium arsenate induced a borderline increase in lung adenomas following intratracheal instillation, but arsenic trisulfide had no effect on tumor incidence. Perinatal treatment of mice with arsenic trioxide resulted in the induction of lung adenomas (Rudnay and Börzsönyi 1981), and intratracheal instillation of the same compound in hamsters resulted in respiratory tract carcinomas, adenomas, papillomas and adenomatoid lesions (Ishinishi et al., 1983; Pershagen et al., 1984a,b).

### 4.3. OTHER ROUTES OF EXPOSURE

Osswald and Goertle (1971) reported a high incidence (11/19) of lymphocytic leukemia or lymphomas in female Swiss mice injected intravenously with 0.5 mg As/kg (as sodium arsenate) once per week for 20 weeks. In a second study with pregnant mice injected subcutaneously with 0.5 mg/kg, once per day for 20 days during pregnancy, 11 of 24 developed the same types of tumors.

DiPaolo and Casto (1979) reported that sodium arsenate induced cell transformations *in vitro* in Syrian hamster embryo cells, and Casto et al. (1979) reported that sodium arsenite enhanced virus-induced cell transformation.

#### **4.4. EPA WEIGHT-OF-EVIDENCE**

##### **4.4.1. Oral**

Classification -- A; human carcinogen (U.S. EPA, 1991b)

Basis -- Increased skin cancer incidence in several populations consuming drinking water with high arsenic concentrations.

##### **4.4.2. Inhalation**

Classification -- A; human carcinogen (U.S. EPA, 1991a)

Basis -- Increased lung cancer mortality in populations exposed primarily through inhalation.

#### **4.5. SLOPE FACTORS**

##### **4.5.1. Oral**

SLOPE FACTOR:  $1.0\text{E-}3$  ( $\mu\text{g/kg/day}$ )<sup>-1</sup> (females) and  $2.0\text{E-}3$  ( $\mu\text{g/kg/day}$ )<sup>-1</sup> (males) (U.S. EPA, 1987). These slope factors were based on unit risks of  $3\text{E-}5$  (females) and  $7\text{E-}5$  ( $\mu\text{g/L}$ )<sup>-1</sup> (males) that were used to derive a single drinking water unit risk as shown below.

DRINKING WATER UNIT RISK:  $5\text{E-}5$  ( $\mu\text{g/L}$ )<sup>-1</sup> (U.S. EPA, 1991a).

PRINCIPAL STUDIES: Tseng et al., 1968; Tseng, 1977

VERIFICATION DATE: Not given.

COMMENT: The final unit risk is the arithmetic mean of the unit risks derived for females and males in a population in Taiwan exposed to arsenic in drinking water. Uncertainties associated with this unit risk involve the dose-response relationship, particularly in regard to (1) differential mortality due to other arsenic-induced diseases, (2) the possibility that ingestion of arsenic-contaminated foods contributed to the effects, and (3) the shape of the dose-response curve at low doses. A memorandum from the EPA administrator noted that the "uncertainties associated with ingested inorganic arsenic are such that estimates could be modified downwards as much as an order of magnitude, relative to risk estimates associated with most other carcinogens."

##### **4.5.2. Inhalation**

SLOPE FACTOR:  $5.0\text{E+}1$  ( $\text{mg/kg/day}$ )<sup>-1</sup> (U.S. EPA, 1992)

INHALATION UNIT RISK:  $4.3\text{E-}3$  ( $\mu\text{g/m}^3$ )<sup>-1</sup> (U.S. EPA, 1991a)

PRINCIPAL STUDIES: Brown and Chu, 1983a-c, Lee-Feldstein, 1983; Higgins, 1982; Enterline and Marsh, 1982.

VERIFICATION DATE: 01/13/88

COMMENT: The final unit risk is the geometric mean of the geometric means for distinct exposed populations of workers at two different copper smelters. It was assumed that the increase in age-specific mortality was a function only of cumulative exposure. The unit risk should not be used if the air concentration exceeds  $2 \mu\text{g/m}^3$  (U.S. EPA, 1992).

## **5. REFERENCES**

ACGIH (American Conference of Governmental Industrial Hygienists). 1986. Documentation of TLVs. Arsenic. American Conference of Governmental Industrial Hygienists, Cincinnati, OH. p. 39.

Aly, S. Mousa; El-Kahky, M.; Saleh, A.; El-Mofty, A. 1975. Toxic deafness. Histological study of the effect of arsenic, salicylates, and quinine on the organ of Corti of guinea pigs. *J. Egypt. Med. Assoc.* 58:144-157. (Cited in U.S. EPA, 1984).

Aranyi, C.; Bradof, J.N.; O'Shea, W.J.; Graham, J.A.; Miller, F.J. 1985. Effects of arsenic trioxide inhalation exposure on pulmonary antibacterial defenses in mice. *J. Toxicol. Environ. Health* 15:163-172.

Armstrong, C.W.; Stroube, R.B.; Rubio, T.; Siudyla, E.A.; Miller, G.B. 1984. Outbreak of fatal arsenic poisoning caused by contaminated drinking water. *Arch. Environ. Health* 39:276-279.

ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for Arsenic. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, Atlanta, GA. ATSDR/TP-88/02.

Axelsson, O.; Dahlgren, E.; Jasson, C.-D.; Rehnlund, S.O. 1978. Arsenic exposure and mortality: a case-referent study from a Swedish copper smelter. *Br. J. Ind. Med.* 35:8-15. (Cited in ATSDR, 1989)

Baroni, C.; van Esch, G.J.; Saffiotti, U. 1963. Carcinogenesis tests of two inorganic arsenicals. *Arch. Environ. Health* 7:668-674.

Baxley, M.N.; Hood, R.D.; Vedel, G.C.; Harrison, W.P.; Szczech, G.M. 1981. Prenatal toxicity of orally administered sodium arsenite in mice. *Bull. Environ. Contam. Toxicol.* 26:749-756.

Beaudoin, A.R. 1974. Teratogenicity of sodium arsenate in rats. *Teratology* 10:153-158. (Cited in U.S. EPA, 1984).

Bettley, F.R.; O'Shea, J.A. 1975. The absorption of arsenic and its relation to carcinoma. *Br. J. Dermatol.* 92:563. (Cited in Hindmarsh and McCurdy, 1986).

Blair, P.C.; Thompson, M.B.; Morrissey, R.E.; et al. 1990. Comparative toxicity of arsine gas in B6C3F1 mice, Fischer 344 rats, and Syrian golden hamsters: system organ studies and comparison of clinical indices of exposure. *Fundam. Appl. Toxicol.* 14:776-787.

Blakely, B. R.; Sisodia, C.S.; Mukkur, T.K. 1980. The effect of methylmercury, tetraethyl lead, and sodium arsenite on the humoral immune response in mice. *Toxicol. Appl. Pharmacol.* 52:245-254.

Blom, S.; Lagerkvist, B.; Linderholm, H. 1985. Arsenic exposure to smelter workers: clinical and neurophysiological studies. *Scand. J. Work Environ. Health* 11:265-270.

Borgono, J.M.; Greiber, R. 1972. Epidemiological study of arsenism in the city of Antofagasta. In: *Trace Substances in Environmental Health*, vol. 5. D.C. Hemphill, ed. University of Missouri, Columbia, MS. pp. 13-24.

Borgono, J.M.; Vincent, P.; Venturino, H.; Infante, A. 1977. Arsenic in the drinking water of the city of Antofagast; epidemiological and clinical study before and after the installation of the treatment plant. *Environ. Health Perspect.* 19:103-106.



Brown, C.C.; Chu, K.C. 1983a. Approaches to epidemiologic analysis of prospective and retrospective studies: Example of lung cancer and exposure to arsenic. In: Risk Assessment Proc. SIMS Conf. on Environ. Epidemiol. June 28 -July 2, 1982, Alta VT. (Cited in U.S. EPA, 1992).

Brown, C.C.; Chu, K.C. 1983b. Implication of the multistage theory of carcinogenesis applied to occupational arsenic exposure. J. Natl. Cancer Inst. 70:455-463. (Cited in U.S. EPA, 1992).

Brown, C.C.; Chu, K.C. 1983c. A new method for the analysis of cohort studies, implications of the multistage theory of carcinogenesis applied to occupational arsenic exposure. Environ. Health Perspect. 50:293-308. (Cited in U.S. EPA, 1992).

Brown, M.M.; Rhyne, B.C.; Goyer, R.A.; Fowler, B.A. 1976. Intracellular effects of chronic arsenic administration on renal proximal tubule cells. J. Toxicol. Environ. Health 1:505-514.

Brown, L.M.; Pottern, L.M.; Blot, W.J. 1984. Lung cancer in relation to environmental pollutants emitted from industrial sources. Environ. Res. 34:250-261.

Burk, D.; Beaudoin, A.R. 1977. Arsenate-induced renal agenesis in rats. Teratology 16:247-260.

Byron, W.R.; Bierbower, G.W.; Brouwer, J.B.; Hansen, W.H. 1967. Pathologic changes in rats and dogs from two-year feeding of sodium arsenite or sodium arsenate. Toxicol. Appl. Pharmacol. 10:132-147.

Casto, B.C.; Meyers, J.; DiPaolo, J.A. 1979. Enhancement of viral transformation for evaluation of the carcinogenic or mutagenic potential of inorganic metal salts. Cancer Res. 39:193-198.

Cebrian, M.E.; Albores, A.; Aguilar, M.; Blakely, E. 1983. Chronic arsenic poisoning in the north of Mexico. Hum. Toxicol. 2:121-133.

Chen, C.J.; Chuang, Y.C.; Lin, T.M.; Wu, H.Y. 1985. Malignant neoplasms among residents of a Blackfoot disease-endemic area in Taiwan: High-arsenic artesian well water and cancers. Cancer Res. 45:5895-5899.

Chen, C.J.; Chuang, Y.C.; You, S.L.; Lin, T.M.; Wu, H.Y. 1986. A retrospective study on malignant neoplasms of bladder, lung, and liver in a Blackfoot disease-endemic area in Taiwan. Br. J. Cancer 53:399-405.

Chen, C.J.; Wu, S.; Lee, J.; et al. 1986. Atherogenicity and carcinogenicity of high-arsenic artesian well water: Multiple risk factors and related malignant neoplasms of blackfoot disease. Arteriosclerosis 8:452-460. (Cited in Hansen, 1990).

Crecelius, E.A. 1977. Changes in the chemical speciation of arsenic following ingestion by man. Environ. Health Perspect. 19:147-150. (Cited in U.S. EPA, 1984).

Datta, D.V. 1976. Arsenic and noncirrhotic portal hypertension. Lancet 1:433.

DiPaolo, J.A.; Casto, B.C. 1979. Quantitative studies of *in vitro* morphological transformation of Syrian hamster cells by inorganic metal salts. Cancer Res. 39:1008-1013.

Dobson, R.L.; Young, M.R.; Pinto, J.S. 1965. Palmar keratoses and cancer. Arch. Dermatol. 92:553-556.

Douglass, C.D.; Blendermann, E.M. 1961. Observations on the influence of some arsenic compounds on pyruvic oxidase activity *in vitro* and *in vivo*. In: Proc. 5th Inter. Congr. Biochem., vol. 9, p. 582 (Intern. Union Biochem. Symp. Ser., vol. 29, 1963). Macmillan, New York. (Cited in Byron et al., 1967).

- Enterline, P.E.; Henderson, V.L.; Marsh, G.M. 1987. Exposure to arsenic and respiratory cancer. A reanalysis. *Am. J. Epidemiol.* 125(6):929-938.
- Enterline, P.E.; Marsh, G.M. 1982. Mortality among workers exposed to arsenic and other substances in a copper smelter. *Am. J. Epidemiol.* 116:895-910.
- Feldman, R.G.; Niles, C.A.; Kelly-Heyes, M.; Sax, D.S.; Dixon, W.J.; Thompson, D.J.; Landau, E. 1979. Peripheral neuropathy in arsenic smelter workers. *Neurology* 29:939-944.
- Ferm, V.H.; Carpenter, S.J. 1968. Malformations induced by sodium arsenate. *J. Reprod. Fert.* 17:199-201.
- Fierz, U. 1965. Katamnestische Untersuchungen Über die Nebenwirkungen der Therapie mit anorganischen Arsen bei Hautkrankheiten. *Dermatologica* 131:41-58. (Cited in U.S. EPA, 1984)
- Fowler, B.A.; Weissberg, J.B. 1974. Arsine poisoning. *New Eng. J. Med.* 291:1171-1174.
- Fowler, B.A.; Woods, J.S. 1979. The effects of prolonged oral arsenate exposure on liver mitochondria of mice: morphometric and biochemical studies. *Toxicol. Appl. Pharmacol.* 50:177-187.
- Fowler, B.A.; Woods, J.S.; Schiller, C.M. 1979. Studies of hepatic mitochondria structure and function: Morphometric and biochemical evaluation of *in vivo* perturbation by arsenate. *Lab. Invest.* 42:313-320.
- Franzblau, A.; Lilis, R. 1989. Acute arsenic intoxication from environmental arsenic exposure. *Arch. Environ. Health* 44(6):385-390.
- Glaser, U.; Hochrainer, D.; Oldiges, H.; Takenaka, S. 1986. Long-term inhalation studies with nickel oxide and arsenic trioxide aerosols in Wistar rats. *Excerpta Med.* 676:325-328.
- Hamamoto, E. 1955. Infant arsenic poisoning by powdered milk. *Jap. Med. J.* 1649:2-12. (Cited in U.S. EPA, 1984).
- Hansen, E.S. 1990. Shared risk factors for cancer and arteriosclerosis - a review of the epidemiological evidence. *Mutat. Res.* 239:163-179.
- Hatch, G.E.; Boykin, E.; Graham, J.A.; Lewtas, J.; Pott, F.; Loud, K.; Mumford, J.L. 1985. Inhalable particles and pulmonary host defense: *in vivo* and *in vitro* effects of ambient air and combustion particles. *Environ. Res.* 36:67-80.
- Hayes, W.J., Jr. 1982. Pesticide Studies in Man. Williams and Eilkins, Baltimore, MD. pp. 41-50.
- Heyman, A.; Pfeiffer, J.B.; Willett, R.W.; Taylor, H.M. 1956. Peripheral neuropathy caused by arsenical intoxication. *New England J. Med.* 254(9): 401-409.
- Heywood, R.; Sortwell, R.J. 1979. Arsenic intoxication in the rhesus monkey. *Toxicol. Lett.* 3:137-144.
- Higgins, I. 1982. Arsenic and respiratory cancer among a sample of Anaconda smelter workers. Report submitted to the Occupational Safety and Health Administration in the comments of the Kennecott Minerals Company report on the inorganic arsenic rulemaking. (Exhibit 203-5).
- Hindmarsh, J.T.; McCurdy, R.F. 1986. Clinical and environmental aspects of arsenic toxicity. *CRC Crit. Rev. Clin. Lab. Sci.* 23:315-347.

Hindmarsh, J.T.; McLetchie, O.R.; Heffernan, L.P.; Haynie, O.A.; Ellenberger, H.A.; McCurdy, R.F.; Thiebaut, H.J. 1977. Electromyographic abnormalities in chronic environmental arsenicalism. *J. Anal. Toxicol.* 1:270-276.

Hine, C.H.; Pinto, S.S.; Nelson, K.W. 1977. Medical problems associated with arsenic exposure. *J. Occup. Med.* 19(6):391-396.

Holmqvist, I. 1951. Occupational arsenical dermatitis. A study among employees at a copper ore smelting work, including investigations of skin reactions to contact with arsenic compounds. *Acta Derm. Venereol.* 31:1-214.

Hong, H.L.; Fowler, B.A.; Boorman, G.A. 1989. Hematopoietic effects in mice exposed to arsine gas. *Toxicol. Appl. Pharmacol.* 97:173-182.

Hood, R.D.; Bishop, S.L. 1972. Teratogenic effects of sodium arsenate in mice. *Arch. Environ. Health* 24:62-65.

Hood, R.D.; Harrison, W.P. 1982. Effects of prenatal arsenite exposure in hamsters. *Bull. Environ. Contam. Toxicol.* 29:671-678.

Hood, R.D.; Thacker, G.T.; Patterson, B.L. 1977. Effects in the mouse and rat of prenatal exposure to arsenic. *Environ. Health Perspect.* 19:219-222. (Cited in ATSDR, 1989).

Huang, Y.Z.; Qian, X.C.; Wang, G.Q.; Xiao, B.-Y.; Ren, D.D.; Feng, Z.Y.; Wu, J.Y.; Xu, R.J.; Zhang, F. 1985. Endemic chronic arsenism in Xinjiang. *Chin. Med. J. (Eng).* 98:219-222.

Hunter, F.T.; Kip, A.F.; Irvine, J.W. 1942. Radioactive tracer studies on arsenic injected as potassium arsenite. *J. Pharmacol. Exp. Therap.* 76:207-220. (Cited in U.S. EPA, 1984).

IARC (International Agency for Research on Cancer. 1980. Some metals and metallic compounds. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, vol. 23. Geneva.

IARC (International Agency for Research on Cancer (IARC). 1987. Overall Evaluations of Carcinogenicity: an Updating of IARC Monographs Volumes 1 to 42. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, supplement 7. Geneva.

Ishinishi, N.; Osato, K.; Kodama, Y.; Kunitake, E. 1976. Skin effects and carcinogenicity of arsenic trioxide: a preliminary experimental study in rats. In: *Effects and Dose-Response Relationships of Toxic Metals*, G.F. Nordberg, ed. Elsevier Scientific, Amsterdam. pp. 471-479.

Ishinishi, N.; Yamamoto, A.; Hisanaga, A.; Inamasu, T. 1983. Tumorigenicity of arsenic trioxide to the lung in Syrian golden hamsters by intermittent instillations. *Cancer Lett.* 21:141-147. (Cited in IARC, 1987).

Ivankovic, S.; Eisenbrand, G.; Preussmann, R. 1979. Lung carcinoma induction in BD rats after single intratracheal instillation of an arsenic-containing pesticide mixture formerly used in vineyards. *Int. J. Cancer.* 24:786-788. (Cited in IARC, 1980).

Järup, L.; Pershagen, G.; Wall, S. 1989. Cumulative arsenic exposure and lung cancer in smelter workers: a dose-response study. *Am. J. Ind. Med.* 15:31-42.

Katsnelson, B.A.; Neizvestnova, Y.M.; Blokhin, V.A. 1986. Stomach carcinogenesis induction by chronic treatment with arsenic (Russ.). *Vopr. Onkol.* 32:68-73. (Cited in IARC, 1987).

- Knuth, W. 1966-67. Arsenic treatment. *Arch. Klin. Exp. Derm.* 227:228-234. (Cited in IARC, 1980)
- Kroes, R.; Van Logten, M.J.; Berkvins, J.M.; deVries, I.; van Esch, G.J. 1974. Study on the carcinogenicity of lead arsenate and sodium arsenate and the possible synergistic effect of diethylnitrosamine. *Food Cosmet. Toxicol.* 12:671-679.
- Kyle, R.A.; Pease, G.L. 1965. Hematologic aspects of arsenic intoxication. *New Eng. J. Med.* 273(1):18-23.
- Lagerkvist, B.E.A.; Linderholm, H.; Nordberg, G.F. 1986. Vasospastic tendency and Raynaud's phenomenon in smelter workers exposed to arsenic. *Environ. Res.* 39:465-474.
- Lagerkvist, B.E.A.; Linderholm, H.; Nordberg, G.F. 1988. Arsenic and Raynaud's phenomenon. Vasospastic tendency and excretion of arsenic in smelter workers before and after summer vacation. *Int. Arch. Occup. Environ. Health* 60:361-364.
- Landau, E.D.; Thompson, D.J.; Feldman, R.G.; Goble, G.J.; Dixon, W.J. 1977. Selected Noncarcinogenic Effects of Industrial Exposure to Inorganic Arsenic. U.S. Environmental Protection Agency, Washington, DC. EPA 659/6-77-018.
- Lee, A.M.; Fraumeni, J.F., Jr. 1969. Arsenic and respiratory cancer in man - an occupational study. *J. Natl. Cancer Inst.* 42:1045-1052.
- Lee-Feldstein, A. 1983. Arsenic and respiratory cancer in man: Follow-up of an occupational study. In: *Arsenic: Industrial, Biomedical, and Environmental Perspectives*, W. Lederer and R. Fensterheim, eds. Van Nostrand Reinhold, New York.
- Lee-Feldstein, A. 1986. Cumulative exposure to arsenic and its relationship to respiratory cancer among copper smelter employees. *J. Occup. Med.* 28:296-302.
- Lee-Feldstein, A. 1989. A comparison of several measures of exposure to arsenic: matched case control study of copper smelter employees. *Am. J. Epidemiol.* 129:112-124.
- Lundgren, K.D. 1954. Damage in the respiratory organs of workers at a smeltery. *Nord. Hyg. Tidskr.* 3:66-82.
- Lyster, W.R. 1977. Arsenic and sex ratio in man. *Med. J. Austral.* 2:442.
- Mabuchi, K.; Lilienfeld, A.; Snell, L. 1979. Lung cancer among pesticide workers exposed to inorganic arsenicals. *Arch. Environ. Health* 34:312-320.
- Mahaffey, K.R.; Capar, S.G.; Gladen, B.C.; Fowler, B.A. 1981. Concurrent exposure to lead, cadmium, and arsenic: effects on toxicity and tissue metal concentrations in the rat. *J. Lab. Clin. Med.* 98:463-481.
- Mappes, R. 1977. Experiments on excretion of arsenic in urine (Ger.) *Int. Arch. Occup. Environ. Health* 40:267-272. (Cited in ATSDR, 1989).
- Marafante, E.; Vahter, H. 1987. Solubility, retention, and metabolism of intratracheally and orally administered inorganic arsenic compounds in the hamster. *Environ. Res.* 42:72-82.
- Matanoski, G.; Landau, E.; Towascia, J. et al. 1981. Lung Cancer/Mortality in Proximity to a Pesticide Plant. U.S. Public Health Service, Washington, DC. PB80-207376.

Mizuta, N.; Mizuta, M.; Ita, F.; Ito, T.; Uchida, H.; Watanabe, Y.; Akama, H.; Murakami, T.; Hayashi, F.; Nakamura, K.; Yamaguchi, T.; Mizuizawa, W.; Oishi, S.; Matsumura, H. 1956. An outbreak of acute arsenic poisoning caused by arsenic-contaminated soy sauce (shoye). A clinical report of 220 cases. *Bull. Yamaguchi Med. Sch.* 4:131-150. (Cited in U.S. EPA, 1984).

Morris, J.S.; Schmid, M.; Newman, S.; Scheuer, P.J.; Sherlock, S. 1974. Arsenic and noncirrhotic portal hypertension. *Gastroenterology* 64:86-94.

Morton, W.E.; Caron, G.A. 1989. Encephalopathy: an uncommon manifestation of workplace arsenic poisoning? *Am. J. Ind. Med.* 15:1-5.

Nagyimjtenyi, L.; Selyes, A.; Berencsi, G. 1985. Chromosomal aberrations and fetotoxic effects of atmospheric arsenic exposure in mice. *J. Appl. Toxicol.* 5:61-63. (Cited in ATSDR, 1989).

Neiger, R.D.; Osweiler, G.D. 1989. Effect of subacute low level dietary sodium arsenite on dogs. *Fund. Appl. Toxicol.* 13:439-451.

Nevens, F.; Fevery, J.; Van Steenberghe, W.; et al. 1990. Arsenic and non-cirrhotic portal hypertension. *J. Hepatol.* 11:80-85. (Cited in TOXBIB/90/375885)

NIOSH (National Institute for Occupational Safety and Health). 1979. Arsine (arsenic hydroxide) poisoning in the workplace. *Current Intelligence Bulletin* 32. Cincinnati, OH.

Nordström, S.; Beckman, L.; Nordenson, I. 1978a. Occupational and environmental risks in and around a smelter in northern Sweden. I. Variations in birth weight. *Hereditas* 88:43-46.

Nordström, S.; Beckman, L.; Nordenson, I. 1978b. Occupational and environmental risks in and around a smelter in northern Sweden. III. Frequencies of spontaneous abortions. *Hereditas* 88:51-54.

Osato, K. 1977. Effects of oral administration of arsenic trioxide during the suckling stage of rats. *Fukuoka Igaku Zasshi* 68:464-491. (Cited in U.S. EPA, 1984).

Osswald, H.; Goerttler, K. 1971. Arsenic induced leucoses in mice after placental and postnatal application (Ger.). *Verh. Dtsch. Gesellsch. Path.* 55:289-293. (Cited in IARC, 1980).

Ott, M.G.; Holder, B.B.; Gordon, H.I. 1974. Respiratory cancer and occupational exposure to arsenicals. *Arch. Environ. Health* 29:250-255. (Cited in ATSDR, 1989).

Penn, A. 1990. Mutational events in the etiology of arteriosclerotic plaques. *Mutat. Res.* 239:149-162.

Perry, K.; Bowler, R.G.; Buckell, H.M.; Druett, H.A.; Schilling, R.S.F. 1948. Studies in the incidence of cancer in a factory handling inorganic compounds of arsenic - II: clinical and environmental investigations. *Br. J. Ind. Med.* 5:6-15.

Pershagen, G.; Lind, B.; Bjorklund, N.-E. 1982. Lung retention and toxicity of some inorganic arsenic compounds. *Environ. Res.* 29:425-434.

Pershagen, G.; Nordberg, G.; Bjorkland, N.E. 1984a. Carcinomas of the respiratory tract in hamsters given arsenic trioxide and/or benzo-a-pyrene by the pulmonary route. *Environ. Res.* 37:425-432. (Cited in IARC, 1987).

Pershagen, G.; Nordberg, G.; Bjorkland, N.E. 1984b. Experimental evidence on the pulmonary carcinogenicity of arsenic trioxide. *Arch. Toxicol.* 7:403-404. (Cited in IARC, 1987).

- Pershagen, G. 1985. Lung cancer mortality among men living near an arsenic-emitting smelter. *Am. J. Epidemiol.* 122:684-696.
- Pinto, S.S.; McGill, C.M. 1953. Arsenic trioxide exposure in industry. *Ind. Med. Surg.* 22:281-287. (Cited in U.S. EPA, 1984)
- Pomroy, C.; Charbonneau, S.M.; McCullough, R.S.; Tam, G.K.H. 1980. Human retention studies with <sup>74</sup>As. *Toxicol. Appl. Pharmacol.* 53:550. (Cited in Hindmarsh and McCurdy, 1986).
- Reymann, F.; Moller, R.; Nielsen, A. 1978. Relationship between arsenic intake and internal malignant neoplasms. *Arch. Dermatol.* 114:378-381.
- Rozenshtein, I.S. 1970. Sanitary toxicological assessment of low concentrations of arsenic trioxide in the atmosphere. *Hyg. Sanit.* 34:16-22. (Cited in U.S. EPA, 1984).
- Rudnay, P.; Börzsönyi, M. 1981. The tumorigenic effect of treatment with arsenic trioxide (Hung.). *Magyar. Onkol.* 25:73-77. (Cited in IARC, 1987).
- Salcedo, J.C.; Portales, A.; Landecho, E.; Diaz, R. 1984. Transverse study of a group of patients with vasculopathy from chronic arsenic poisoning in communities of the Francisco de Madero and San Pedro Districts, Coahuila, Mexico. *Revista de la Facultad de Medicina de Torreon* 12:16. (Cited in ATSDR, 1989).
- Schaumburg, H.A. 1980. Failure to produce arsenic neurotoxicity in the rat. An experimental study. Office of Toxic Substances, U.S. Environmental Protection Agency, Washington, DC. EPA 560/11-80-022. (Cited in ATSDR, 1989).
- Schroeder, H.A.; Kanisawa, M.; Frost, D.V.; Mitchener, M. 1968. Germanium, tin and arsenic in rats: effects on growth, survival and tissue levels. *J. Nutr.* 96:37-45.
- Schroeder, H.A., Mitchener, M. 1971. Toxic effects of trace elements on the reproduction of mice and rats. *Arch. Environ. Health* 23:102-106.
- Shirachi, D.Y.; Johansen, M.G.; McGowan, J.P.; Tu, S-H. 1983. Tumorigenic effect of sodium arsenite in rat kidney. *Proc. West. Pharmacol. Soc.* 26:413-415. (Cited in IARC, 1987).
- Sommers, S.C.; McManus, R.G. 1953. Multiple arsenical cancers of the skin and internal organs. *Cancer* 6:347-359.
- Squibb, K.S.; Fowler, B.A. 1983. The toxicity of arsenic and its compounds. In: *Biological and Environmental Effects of Arsenic*. B.A. Fowler, ed. Elsevier Science Publishers B.V., New York. pp. 233-269.
- Takahashi, K. 1974. Investigation of chronic arsenic poisoning. *Jap. Public Health Assoc.* (cited in U.S. EPA, 1984).
- Tay, C.H.; Seah, C.S. 1975. Arsenic poisoning from anti-asthmatic herbal preparations. *Med. J. Aust.* 2:424-428.
- Terada, H.; Katsuta, K.; Sasakawa, T.; Saito, T.; Shrota, H.; Fukuchi, K.; Sekiya, E.; Yokoyama, Y.; Hirokawa, S.; Watanabe, G.; Hasegawa, K.; Shina, T.O.; Sekiguchi, E. 1960. Clinical observations of chronic toxicosis by arsenic. *Nihon Rinsho* 18:2394-2403.

Tseng, W.P.; Chu, H.M.; How, S.W.; Fong, J.M.; Lin, C.S.; Yeh, S. 1968. Prevalence of skin cancer in an endemic area of chronic arsenium in Taiwan. *J. Natl. Cancer Inst.* 40:453-463.

Tseng, W.P. 1977. Effects and dose-response relationships of skin cancer and blackfoot disease with arsenic. *Environ. Health Perspect.* 19:109-119.

U.S. Air Force. 1990. Arsenic. In: *The Installation Restoration Program Toxicology Guide*, vol. 5. Wright-Patterson Air Force Base, OH. pp. 75-1 to 75-102.

U.S. EPA. 1984. Health Assessment Document for Arsenic. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Research Triangle Park, NC. EPA 600/8-32-021F.

U.S. EPA. 1987. Special Report on Ingested Arsenic: Skin Cancer; Nutritional Essentiality. Prepared for the Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, DC. EPA/625/3-87/013.

U.S. EPA. 1991a. Integrated Risk Information System (IRIS). Risk Estimate for Carcinogenicity and Reference Dose for Oral Exposure for Arsenic. (Online file, retrieved Nov. 1991). Office of Health and Environmental Assessment, Cincinnati, OH.

U.S. EPA. 1991b. Drinking Water Regulations and Health Advisories. Prepared by the Office of Water. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1992. Health Effects Summary Tables. FYI 1992. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Emergency and Remedial Response. Washington, DC.

Valentine, J.L.; Campion, D.S.; Schluchter, M.D.; Massey, F.J. 1982. Arsenic effects on human nerve conduction. In: *Proceedings of the Fourth International Symposium on Trace Element Metabolism in Man and Animals*, J.M. Gawthorne, J.M. Howell, and C.L. White, eds. Springer-Verlag, New York. pp. 409-412.

Viallet, A.; Guillaume, L.; Cote, J.; Legare, A.; Lavoie, P. 1972. Presinusoidal portal hypertension following chronic arsenic intoxication. *Gastroenterology* 62:177

Webb, D.R.; Wilson, S.E.; Carter, D.E. 1986. Comparative pulmonary toxicity of gallium arsenide, gallium (III) oxide, and arsenic (III) oxide intratracheally instilled into rats. *Toxicol. Appl. Pharmacol.* 82:405-416.

Webb, D.R.; Wilson, S.E.; Carter, D.E. 1987. Pulmonary clearance and toxicity of respirable gallium arsenide particulates intratracheally instilled into rats. *Am. Ind. Hyg. Assoc. J.* 48(7):660-667.

Willhite, C.C.; Ferm, V.H. 1984. Prenatal and developmental toxicology of arsenicals. *Ad. Exp. Med. Biol.* 177:205-228. (Cited in U.S. EPA, 1984)

Wingren, G.; Axelson, O. 1985. Mortality pattern in a glass producing area in S.E. Sweden. *British J. Indust. Med.* 42:411-414.

Woods, J.S.; Fowler, B.A. 1977. Effects of chronic arsenic exposure on hematopoietic function in adult mammalian liver. *Environ. Health Perspect.* 19:209-213.

Woods, J.S.; Fowler, B.A. 1978. Altered regulation of mammalian hepatic heme biosynthesis and urinary porphyrin excretion during prolonged exposure to sodium arsenate. *Toxicol. Appl. Pharmacol.* 43:361-371.

Wu, M.M.; Kuo, T.L.; Hwang, Y.H.; Chen, C.J. 1989. Dose-response relation between arsenic concentration in well water and mortality from cancers and vascular diseases. *Am. J. Epidemiol.* 130:1123-1132.

Zaldivar, R. 1974. Arsenic contamination of drinking water and foodstuffs causing endemic chronic poisoning. *Beitr. Path.* 151:384-400.

Zaldivar, R. 1980. A morbid condition involving cardio-vascular, broncho-pulmonary, digestive and neural lesions in children and young adults after dietary arsenic exposure. *Zbl. Bakt. I. Abt. Orig. B* 170:44-56.



**TOXICITY SUMMARY**  
for  
**BERYLLIUM**

DECEMBER 1992

Prepared by

Mary Lou Daugherty, M.S.

Chemical Hazard Evaluation and Communication Group  
Biomedical and Environmental Information Analysis Section  
Health and Safety Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for

U.S. ARMY TOXIC AND  
HAZARDOUS MATERIALS AGENCY  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Environmental Branch, Technology Division  
U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY  
Aberdeen Proving Ground, Maryland 21010-5401

---

\*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400

## EXECUTIVE SUMMARY

Beryllium is present in the earth's crust, in emissions from coal combustion, in surface water and soil, and in house dust, food, drinking water, and cigarette smoke (U.S. EPA, 1987a). However, the highest risk for exposure occurs among workers employed in beryllium manufacturing, fabricating, or reclamation industries (ATSDR, 1988). Workers encounter dusts and fumes of many different beryllium compounds; the current occupational standard for worker exposure to beryllium is  $2 \mu\text{g}/\text{m}^3$  during an 8-hour workshift (OSHA, 1989).

Inhaled beryllium is absorbed slowly and localizes mainly in the lungs, bone, liver and kidneys (Stiefel et al., 1980; Reeves et al., 1967; Reeves and Vorwald, 1967; Zorn et al., 1988; Tepper et al., 1961; Meehan and Smyth, 1967). Ingested beryllium undergoes limited absorption and localizes in liver, kidneys, lungs, stomach, spleen and the large and small intestines (Crowley et al., 1949; Furchner et al., 1973; Watanabe et al., 1985). Significant absorption of beryllium or its compounds through intact skin is unlikely because of its chemical properties (U.S. EPA, 1987b). Beryllium per se is not biotransformed, but soluble salts may be converted to less soluble compounds in the lung (U.S. EPA, 1987b). Most orally administered beryllium passes through the gastrointestinal tract unabsorbed and is excreted in the feces (Reeves, 1965), whereas inhaled water-soluble beryllium salts are excreted mainly by the kidneys (Zorn et al., 1988).

Limited data indicate that the oral toxicity of beryllium is low. No adverse effects were noted in mice given 5 ppm beryllium in the drinking water in a lifetime bioassay (Schroeder and Mitchener, 1975a,b). The dose (converted to  $0.54 \text{ mg}/\text{kg bw}/\text{day}$ ) was the no-adverse-effect level (NOAEL) used in the calculation of the chronic oral RfD for beryllium of  $0.005 \text{ mg}/\text{kg}/\text{day}$  (U.S. EPA, 1991a).

In contrast, the toxicity of inhaled beryllium is well-documented. Humans inhaling "massive" doses of beryllium compounds (such as the water soluble sulfate, fluoride, chloride, and oxide) may develop acute berylliosis (Constantinidis, 1978). ATSDR (1988) estimated that, based on existing data, the disease could develop at levels ranging from approximately  $2\text{-}1000 \mu\text{g Be}/\text{m}^3$ . This disease usually develops shortly after exposure and is characterized by rhinitis, pharyngitis, and/or tracheobronchitis, and may progress to severe pulmonary symptoms. The severity of acute beryllium toxicity correlates with exposure levels, and the disease is now rarely observed in the United States because of improved industrial hygiene (Zorn et al., 1988; Kriebel et al., 1988b).

Humans inhaling beryllium may also develop chronic berylliosis which, in contrast to acute berylliosis, is highly variable in onset, is more likely to be fatal, and can develop a few months to  $\geq 20$  years after exposure (Constantinidis, 1978; Hall et al., 1959; Kriebel et al., 1988b). Chronic beryllium disease is a systemic disease that primarily affects the lungs and is characterized by the development of non-caseating granulomas. The disease most likely results from a hypersensitivity response to beryllium as evidenced by positive patch tests (Nishimura, 1966) and positive lymphocyte transformation tests (Williams and Williams (1983) in exposed individuals. Granulomas may also appear in the skin, liver, spleen, lymph nodes, myocardium, skeletal muscles, kidney, bone, and salivary glands (Kriebel et al., 1988b; Freiman and Hardy, 1970).

Epidemiologic studies have suggested that beryllium and its compounds could be human carcinogens. In a study that covered 15 regions of the U.S., Berg and Burbank (1972) found a significant correlation between cancers of the breast, bone and uterus and the concentration and detection frequency of beryllium in drinking water. However, imperfect analytical and sampling methods used in the study prompted the U.S. EPA (1986b) to conclude that these results are not proof of cause and effect relationships between cancer and beryllium in drinking water. Studies in workers exposed to beryllium, mostly via inhalation, have shown significant increases in observed over expected lung cancer incidences (Bayliss et al., 1971; Bayliss and Lainhart, 1972; Bayliss and Wagoner, 1977; Wagoner et al., 1980; Mancuso, 1970; 1979; 1980). The U.S. EPA (1986a), in evaluating the

total database for the association of lung cancer with occupational exposure to beryllium, noted several limitations, but concluded that the results must be considered to be at least suggestive of a carcinogenic risk to humans. In laboratory studies, beryllium sulfate caused increased incidences of pulmonary tumors in rats and rhesus monkeys (Vorwald, 1953, 1962, 1968; Vorwald et al., 1955, 1966; Schepers et al., 1957; Reeves and Deitch, 1969).

Based on sufficient evidence for animals and inadequate evidence for humans, beryllium has been placed in the EPA weight-of-evidence classification B2, probable human carcinogen (U.S. EPA, 1991a). For inhalation exposure, the unit risk value is  $2.4\text{E-}3$  ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup>, and the slope factor is  $8.4$  ( $\text{mg}/\text{kg}/\text{day}$ )<sup>-1</sup> (U.S. EPA, 1991b). For oral exposure, the unit risk value is  $1.2\text{E-}4$  ( $\mu\text{g}/\text{L}$ )<sup>-1</sup> and the slope factor is  $4.3$  ( $\text{mg}/\text{kg}/\text{day}$ )<sup>-1</sup> (U.S. EPA, 1991a).

## 1. INTRODUCTION

Beryllium (Be), a metallic element, belongs to Group IIA of the periodic table and has an atomic weight of 9.012 and an oxidation state of +2 (U.S. EPA, 1987a; Budavari et al., 1989). Beryllium occurs naturally in the earth's crust at concentrations ranging from 2-10 ppm. It is also released into the atmosphere from coal combustion at concentrations of ~0.01-0.1 ng/m<sup>3</sup>, most likely as beryllium oxide (U.S. EPA, 1987a). Beryllium occurs in house dust (0.05-0.1 µg/g), surface water (0.01-1.0 ng/g), and soil (0.3-6.0 µg/g) (U.S. EPA, 1987a). Total daily intake values for beryllium in the general population are estimated at 1.6 ng/day in air, 120 ng in food, and 285 ng in water (U.S. EPA, 1987b). In addition, a smoker of one pack of cigarettes/day could inhale up to 700 ng of beryllium, depending on the type of tobacco used (U.S. EPA, 1987b).

Currently, beryllium has many industrial uses (e.g., in brake systems of airplanes, for neutron monochromatization, as window material for x-ray tubes, and in radiation detectors) (Zorn et al., 1988). The commercially important compound, beryllium oxide, is used in the electronics industry as a substrate for transistors and silicon chips, coil cores, and laser tubes (Zorn et al., 1988).

Although beryllium ore is relatively nontoxic, all other commercially important beryllium compounds exhibit significant pulmonary toxicity (ATSDR, 1988). Individuals employed in beryllium manufacturing, fabricating, or reclaiming industries are at highest risk for exposure and may encounter dusts and fumes of many different beryllium compounds. The current occupational standard for worker exposure to beryllium is 2 µg/m<sup>3</sup> over an 8-hour workshift (OSHA, 1989). The U.S. EPA (1987b) reports that new cases of chronic beryllium disease are surfacing in industries where the OSHA standard is exceeded, but that few cases have been reported where levels do not exceed 2 µg/m<sup>3</sup>.

## 2. METABOLISM AND DISPOSITION

### 2.1. ABSORPTION

The gastrointestinal absorption of beryllium and its compounds is limited; instead, these compounds form insoluble precipitates at about pH 7 (Zorn et al., 1988) and pass out of the g.i. tract unabsorbed (Reeves, 1965; Furchner et al., 1973). Two studies in which beryllium was given orally to animals as <sup>7</sup>Be in single or repeated doses demonstrated that <1% of the administered beryllium was absorbed (Crowley et al., 1949; Furchner et al., 1973). In another study, rats given beryllium sulfate (6.6 or 66.6 µg beryllium/day) in drinking water for up to 24 weeks eliminated 60-90% in the feces, suggesting at first that significant absorption had taken place; however, further analysis of the recovery data revealed that the metal was probably precipitated as the phosphate and was not available for absorption (Reeves, 1965).

The small amount of gastrointestinal absorption of beryllium that does occur depends on the specific compound administered. In hamsters, the absorption of soluble beryllium sulfate from the g.i. tract exceeded that of insoluble beryllium oxide and beryllium metal (Watanabe et al., 1985); and in rats, the absorption of beryllium oxide exceeded that of the hydroxide, and the absorption of beryllium fluoride exceeded that of the chloride, sulfate, nitrate, and hydroxide (Bugryshev et al., 1984). Reeves (1965) concluded from his studies that most of the beryllium found in the body was absorbed from the stomach at pH values (3.0-3.6 in the rat) that are favorable for maintaining beryllium salts in their ionized and soluble form.

Beryllium is slowly absorbed and retained by the lungs (Stiefel et al., 1980; Reeves et al., 1967; Reeves and Vorwald, 1967; Zorn et al., 1988). In one study, rats and guinea pigs were exposed for 3 hours to beryllium sulfate aerosol containing <sup>7</sup>Be added as the chloride (Zorn et al., 1977). Of the <3 mg of beryllium that were inhaled, 10 ng were <sup>7</sup>Be. Immediately after exposure, ~5 ng of <sup>7</sup>Be were retained, 67% in the lungs and 15% in the skeleton. In another study, levels of beryllium reached steady state in the blood of rats and guinea pigs after

8 to 12 hours of exposure to beryllium nitrate ( $35 \mu\text{g}/\text{m}^3 \text{ Be}$ ), and equilibrated in the lungs of rats after 32 weeks of exposure to beryllium sulfate ( $35 \mu\text{g}/\text{m}^3 \text{ Be}$ ) (Stiefel et al., 1980).

Dermal absorption of water-soluble beryllium sulfate or beryllium chloride occurred at pH 3 in animal experiments (Zorn et al., 1988); however, U.S. EPA (1987b) concluded that significant absorption of beryllium or its compounds through intact skin is unlikely because of its chemical properties.

## **2.2. DISTRIBUTION**

Watanabe et al. (1985) studied the distribution of beryllium in groups of hamsters given several different beryllium compounds in the diet for 3 to 12 months. The animals were sacrificed for tissue examination at various times. Beryllium administered as the soluble sulfate localized in liver, large intestine, small intestine, kidneys, lungs, stomach, and spleen; whereas beryllium administered as beryllium metal or beryllium oxide, both insoluble, localized mainly in the large and small intestines. Zorn et al. (1988) reported that a portion of beryllium or its compounds is stored in the liver and skeleton.

Analysis of tissues from workers exposed to beryllium via inhalation revealed that the highest levels of the metal were in the lungs, then bone, liver, and kidneys (Tepper et al., 1961; Meehan and Smyth, 1967).

## **2.3. METABOLISM**

Beryllium is not biotransformed, but soluble salts may be converted to less soluble compounds in the lung (U.S. EPA, 1987b).

## **2.4. EXCRETION**

Animal studies have shown that most orally administered beryllium passes through the gastrointestinal tract unabsorbed and is excreted in the feces. In one study, rats given beryllium sulfate ( $6.6$  or  $66.6 \mu\text{g}$  beryllium/day) in drinking water for up to 24 weeks eliminated 60-90% in the feces and <1% in the urine (Reeves, 1965). Another study demonstrated that urinary beryllium levels for rats fed beryllium sulfate doses of 5, 50, or 500 mg/kg for 2-years were proportional to intake (Morgareidge et al., 1977).

Inhaled water-soluble beryllium salts are excreted mainly by the kidneys, with a half-life of 2-8 weeks (Zorn et al., 1988). Stiefel et al. (1980) found increased levels of beryllium in the urine of cigarette smokers ( $2 \mu\text{g}/\text{L}$  compared with  $0.9 \mu\text{g}/\text{L}$ , normal level); in animals, urinary elimination of beryllium peaked at  $300 \text{ ng/g}$  10 hours after exposure ended. Stress, such as that brought on by pregnancy or major surgery, may mobilize beryllium in the body, and excretion of the metal in the urine may continue for years. Thus, urinary concentrations of beryllium at any point in time reflect only the amount released, and not the total body burden (Parkes, 1984).

Beryllium particles are cleared slowly from the lungs. Sanders et al. (1975) measured the clearance of beryllium oxide in rats and hamsters. Females of both species had slower clearance than did males. Reeves and Vorwald (1967) made similar observations in rats exposed to beryllium sulfate, and reported that the clearance half-time exceeded 63 days. Rhoads and Sanders (1985) reported that the half-time for removal of 50% of the initial lung burden of beryllium, following up to 3 hours of exposure to the metal, was 400 days.

### **3. NONCARCINOGENIC HEALTH EFFECTS**

#### **3.1. ORAL EXPOSURES**

##### **3.1.1. Acute Toxicity**

###### **3.1.1.1. Human**

Information on the acute toxicity of beryllium following oral exposure to humans was unavailable.

###### **3.1.1.2. Animal**

Acute oral LD<sub>50</sub> values for beryllium range from 18 mg Be/kg as beryllium fluoride in the mouse to 200 mg Be/kg as beryllium chloride in the rat (Reeves, 1986).

##### **3.1.2. Subchronic Toxicity**

Information on the subchronic toxicity of beryllium following oral exposure to humans and animals was unavailable.

##### **3.1.3. Chronic Toxicity**

###### **3.1.3.1. Human**

Information on the chronic toxicity of beryllium following oral exposure to humans was unavailable.

###### **3.1.3.2. Animal**

In early studies, chronic feeding of large doses of beryllium carbonate (0.1-0.5%, 1-5 g/kg of food) to young animals produced rickets (Guyatt et al., 1933; Jacobson, 1933; Kay and Skill, 1934). This effect was thought to be the result of the binding of phosphate to beryllium in the gut and the subsequent depletion of phosphorus in the body. In a two-year feeding study, rats were given dietary levels of 5, 50, or 5000 ppm beryllium (as beryllium sulfate) (Morgareidge et al., 1977). Animals of the 5000 ppm group (5 g/kg of food) had slightly decreased body weights. U.S. EPA (1991a) indicates that an unpublished dietary study by Cox et al. (1975) provided a NOEL of 25 mg/kg/day for beryllium.

Groups of approximately 50 male and female Long-Evans rats and Swiss mice received drinking water containing 5 ppm beryllium sulfate for life (Schroeder and Mitchener, 1975a,b). Body weights were measured throughout the study, and at the time of death, the animals were dissected and gross pathology recorded. Blood and urine samples were taken from the rats only. A slight depression in growth rate was observed for male rats at 2-6 months of age and glucose was detected in the urine of the female rats ( $p < 0.025$ , compared with control values, Chi square analysis). No other consistent differences were noted between treated and control rats regarding urinalysis, or serum glucose, uric acid, and cholesterol. No differences were noted between treated and control mice.

##### **3.1.4. Developmental and Reproductive Toxicity**

Information on the developmental/reproductive toxicity of beryllium following oral exposure to humans or animals was unavailable.

### 3.1.5. Reference Dose

#### 3.1.5.1. Subchronic

ORAL RfD: 0.005 mg/kg/day (U.S. EPA, 1992)

UNCERTAINTY FACTOR: 100

NOAEL: 5 ppm in drinking water (0.54 mg/kg bw/day)

COMMENT: The principal study (Schroeder and Mitchener, 1975) is the same for the subchronic and chronic RfD and is described in section 3.1.3.2.

#### 3.1.5.2. Chronic

ORAL RfD: 0.005 mg/kg/day (U.S. EPA, 1991)

UNCERTAINTY FACTOR: 100

NOAEL: 5 ppm in drinking water (0.54 mg/kg bw/day)

CONFIDENCE:

Study: Low

Data Base: Low

RfD: Low

VERIFICATION DATE: 12/02/85

PRINCIPAL STUDY: Schroeder and Mitchener, 1975

COMMENTS: The NOAEL was based on no effects in rats in a lifetime bioassay. The uncertainty factor of 100 reflects a factor of 10 each for interspecies conversion and for the protection of sensitive human subpopulations. The RfD is limited to soluble beryllium salts.

### 3.2. INHALATION EXPOSURES

#### 3.2.1. Acute Toxicity

##### 3.2.1.1. Human

Acute beryllium diseases in humans result from the inhalation of high concentrations of highly dispersed forms of beryllium or its compounds (Zorn et al., 1988). Individuals inhaling massive doses of beryllium compounds (such as the water soluble sulfate, fluoride, chloride, and oxide) may develop acute berylliosis (Constantinidis, 1978). This disease usually develops shortly after exposure and is characterized by rhinitis, pharyngitis, and/or tracheobronchitis, and may progress to severe pulmonary disease. The severity of acute beryllium toxicity correlates with exposure levels (Zorn et al., 1988). Brief exposure to concentrations of beryllium in air above 100  $\mu\text{g}/\text{m}^3$ , may cause acute pneumonitis characterized by shortness of breath, malaise, anorexia, weight loss, coughing, cyanosis, tachypnea and tachycardia (U.S. EPA, 1987; Eisenbud et al., 1948). Lung volumes are reduced and diffuse or localized infiltrates are seen on the chest x-ray (Kriebel et al., 1988b). Although some cases of acute beryllium disease are fatal, most are resolved within a few months (Dutra, 1948). Sprince et al. (1983) reported that 17% of a group of patients with the acute disease developed chronic disease in 10 or more years. Acute beryllium disease is now rarely observed in the United States because of improved industrial hygiene (Kriebel et al., 1988b).

##### 3.2.1.2. Animal

LC<sub>50</sub> values for beryllium were not found in the available literature. In rats, the lethal dose for acute inhalation of beryllium sulfate was 10 mg of the salt/m<sup>3</sup> 6 hours/day for 5 days (Stiefel et al., 1980).

Brief exposures to beryllium can result in long-term effects. In a pulmonary toxicity study, male rats were exposed for one hour in a nose only chamber to an aerosol of 4.05  $\mu\text{g}$  of Be/L (as beryllium sulfate) and

were examined for toxicity for a year after exposure (Sendelbach et al., 1989). Parameters for lung toxicity included bronchoalveolar lavage, lung cell kinetics, and histopathologic analysis. The activities of alkaline phosphatase (Alk Pase), acid phosphatase (Ac Pase), and lactate dehydrogenase (LDH) in lavage fluids were elevated 3 weeks after exposure; Alk Pase and LDH levels peaked 3 months after. Microscopic examination revealed progressive focal interstitial pneumonitis with a prominent alveolar component of heteromorphic macrophages, neutrophils, and debris.

In a similar study, higher concentrations of beryllium (800  $\mu\text{g Be metal/m}^3$  for 50 min; initial lung burden, 625  $\mu\text{g}$ ) caused severe, acute chemical pneumonitis that is followed by a quiescent period of minimal inflammation and mild fibrosis (Haley et al., 1990). Progressive, chronic-active, fibrosing pneumonitis appeared later.

### **3.2.2. Subchronic Toxicity**

#### **3.2.2.1. Human**

Information on the subchronic toxicity of beryllium following inhalation exposure to humans was unavailable.

#### **3.2.2.2. Animal**

The respiratory tract is the target for the subchronic inhalation toxicity of beryllium. Schepers et al. (1957) exposed 115 male and female Sherman and Wistar rats to 35  $\mu\text{g/m}^3$  of beryllium (as beryllium sulfate) 8 hours/day, 5 days/week and 4 hours/day 1 day/week for 180 days. During exposure, 46 exposed rats died from a bacterial infection that affected the heart and lungs. At the end of exposure, 17 rats were sacrificed and examined for pulmonary effects. Foam-cell clusters, infiltration of macrophages, lobular septal-cell proliferation and peribronchial and alveolar-wall epithelialization were observed in the treated animals. Untreated controls had none of these effects. Fifty-two of the exposed rats were maintained in beryllium-free air for up to 18 months. These animals demonstrated a progressive increase in the frequency of pulmonary changes that included atrophic-vesicular emphysema and metaplasia of the bronchial epithelium.

A dose-response for pulmonary effects was suggested in a study of rats exposed to beryllium sulfate aerosol 7 hours/day for 1-560 days (Vorwald et al., 1966). The animals exhibited no specific inflammatory abnormalities at an aerosol concentration of 2.8  $\mu\text{g/m}^3$ , significant inflammatory changes at 21  $\mu\text{g/m}^3$ , chronic pneumonitis at 42  $\mu\text{g/m}^3$ , and acute berylliosis at 194  $\mu\text{g/m}^3$ . Durations of exposure associated with these effects were not clear.

Tumors developed in animals in both of the above studies; these are discussed in Section 4.

### **3.2.3. Chronic Toxicity**

#### **3.2.3.1. Human**

Humans inhaling beryllium may develop chronic berylliosis which, in contrast to acute berylliosis, is highly variable in onset and can develop a few months to  $\geq 20$  years after exposure (Constantinidis, 1978; Kriebel et al., 1988b). Exposure lasting for months to years is essential for the development of the disease (Kriebel et al., 1988b).

The risk of disease, estimated at 1 to 10% (Eisenbud and Lisson, 1983), is probably related to both the magnitude of the exposure and the type of beryllium compound. The more soluble compounds apparently cause the acute disease; whereas, the less soluble compounds are more likely to be associated with the chronic disease (Machle et al., 1948). This suggests that the risks are now much lower as a result of the increased effectiveness



of current occupational and environmental controls (Kriebel et al., 1988b). In at least one exception to this, five workers developed lung granulomas after working in an area where beryllium fume concentrations were consistently  $<2 \mu\text{g}/\text{m}^3$ , the OSHA standard (Cullen et al. 1987). However, the investigators suspect that exposure was underestimated because of the collection method used.

Chronic beryllium disease is a systemic, granulomatous disease that primarily affects the lungs (Kriebel et al., 1988b). Non-caseating granulomas may also be observed in the skin, liver, spleen, lymph nodes, myocardium, skeletal muscles, kidney, bone, and salivary glands (Freiman and Hardy, 1970). Other symptoms of the disease include dyspnea, weight loss, chest pain, cough, arthralgias, and fatigue (Kriebel et al., 1988b). Physical findings include bibasilar crackles, skin lesions, hepatosplenomegaly, clubbing of the nail beds, and lymphadenopathy, and in severe cases, right heart failure and cor pulmonale may occur (Kriebel et al., 1988b). X-rays may show diffuse infiltrates and hilar adenopathy. In addition, a cross-sectional study conducted on 297 white male workers employed for an average of 17 years in a large beryllium plant, revealed decrements in pulmonary function (Kriebel et al., 1988a).

Chronic pulmonary beryllium disease proceeds at one of the following three levels, as characterized by Zorn et al. (1988): (1) after the onset of lung function diminution, the pathological changes regress, leaving minimal fibrosis and respiratory impairment; (2) following an asymptotic period of 2-30 years, the disease "burns out" at a more advanced fibrotic stage with little effect on the overall life expectancy; or (3) a continuous activity with progressive inflammatory and fibrotic changes, resulting in increasing respiratory disability such as shortness of breath on exertion, chronic dry cough, and burning substernal pain. The progressive form of berylliosis is associated with decreased life expectancy.

The Beryllium Case Registry (BCR) at the Massachusetts General Hospital requires that at least four of the following six criteria be met for diagnosis of chronic beryllium disease: (1) epidemiologic evidence of significant beryllium exposure; (2) presence of beryllium in lung tissue, lymph nodes, or urine; (3) evidence of lower respiratory tract disease and a clinical course consistent with beryllium disease; (4) radiologic evidence of interstitial disease consistent with a fibronodular process; (5) evidence of a restrictive or obstructive ventilatory defect or diminished carbon monoxide diffusing capacity; (6) pathologic changes consistent with beryllium disease on examination of lung tissue and/or lymph nodes (Sprince and Kazemi, 1983).

The disease most likely results from a hypersensitivity response to beryllium as evidenced by positive patch tests (Nishimura, 1966) and positive lymphocyte transformation tests (Williams and Williams, 1983). Circulating humoral antibodies to beryllium have never been demonstrated, thus, the hypersensitivity to beryllium appears to be strictly cell-mediated (Reeves, 1979; Stiefel et al., 1980). A predisposition to the development of chronic beryllium disease, consistent with the inability of susceptible individuals to develop a sufficient number of suppressor cells to prevent the immune response from becoming excessive and destructive against autologous lung tissue, has been suggested (Zorn et al., 1988).

The chronic disease is more likely to be fatal than the acute disease. For example, in a study of 601 cases of berylliosis (61% were chronic), 31% of the patients with chronic disease died compared with 6% of the acute cases (Hall et al., 1959).

#### 3.2.3.2. Animal

Rats exposed 7 hours/day, 5 days/week for 72 weeks to  $34 \mu\text{g}/\text{m}^3$  of beryllium (as beryllium sulfate) had increased lung weights and inflammatory and proliferative changes and clusters of macrophages in the alveolar spaces (Reeves et al., 1967).

See also the section on subchronic exposure, inhalation effects (3.2.2.2).

### **3.2.4. Developmental and Reproductive Toxicity**

Information on the developmental/reproductive toxicity of beryllium following inhalation exposure to humans and animals was unavailable.

### **3.2.5. Reference Concentration**

A subchronic or chronic reference concentration for beryllium was not available.

## **3.3. OTHER ROUTES OF EXPOSURE**

### **3.3.1. Acute Toxicity**

#### **3.3.1.1. Human**

Beryllium is a direct irritant and may cause edema and inflammation of any contacted tissue (Kriebel et al., 1988b). The eyes and skin are common targets of the acute irritant effects of beryllium (Kriebel et al., 1988b). Cutaneous injuries from beryllium metal, alloys, or oxide may require surgical excision of the foreign substance to promote healing (Zorn et al., 1988). In addition to primary dermatitis, beryllium may sensitize the skin to subsequent contact with the metal. Dermatitis usually abates after exposure stops, but ulceration can result from particles retained in the skin (Kriebel et al., 1988b).

#### **3.3.1.2. Animal**

Information on the acute toxicity of beryllium following exposure to animals by other routes was unavailable.

### **3.3.2. Subchronic Toxicity**

Information on the subchronic toxicity of beryllium following exposure to humans or animals by other routes was unavailable.

### **3.3.3. Chronic Toxicity**

#### **3.3.3.1. Human**

Chronic dermal contact by beryllium and its compounds may result in skin sensitization and contact dermatitis in predisposed persons (Zorn et al., 1988).

#### **3.3.3.2. Animal**

Information on the chronic toxicity of beryllium following exposure to animals by other routes was unavailable.

### **3.3.4. Developmental and Reproductive Toxicity**

Information on the developmental/reproductive toxicity of beryllium following exposure to humans by other routes was unavailable.

#### **3.3.4.2. Animal**

Intratracheal injection of rats with 50 mg/kg of beryllium chloride or beryllium oxide on (one or more) days 3, 5, or 8 of gestation produced increases in fetal mortality, decreases in fetal weight, and increases in the percentages of pups with internal abnormalities (Selivanova and Savinova, 1986).

Rats, treated intratracheally with beryllium oxide (0.2 mg beryllium/rat) and allowed to mate repeatedly over 15 months, displayed no change in reproductive performance (Clary et al., 1975).

### **3.4. TARGET ORGANS/CRITICAL EFFECTS**

#### **3.4.1. Oral Exposures**

##### **3.4.1.1. Primary Target Organs**

Skeletal system: Rickets in young animals appeared to be the result of the binding of phosphate to beryllium in the gut.

##### **3.4.1.2. Other Target Organs**

None

#### **3.4.2. Inhalation Exposures**

##### **3.4.2.1. Primary Target Organs**

Lungs: Chronic beryllium disease is characterized as an immunologically mediated granulomatous lung disease in humans and appears to be the result of direct chemical toxicity and foreign-body-type reactions in rats.

##### **3.4.2.2. Other Target Organs**

Skin, liver, spleen, lymph nodes, myocardium, skeletal muscles, kidney, bone, and salivary glands may exhibit granulomas, similar to those of the lungs.

## **4. CARCINOGENICITY**

### **4.1. ORAL EXPOSURES**

#### **4.1.1. Human**

In the late 1970's, epidemiological studies suggested that beryllium and its compounds could be human carcinogens. In a study that covered 15 regions of the U.S., Berg and Burbank (1972) found a significant correlation between cancers of the breast, bone, and uterus and the concentration and detection frequency of beryllium in drinking water. Mortality rates in areas with beryllium in the drinking water were excessive only for nonwhite males. The probability of a positive association ranged from 0.006-0.040. However, imperfect analytical and sampling methods used in the study prompted the U.S. EPA (1986b) to conclude that these results were not proof of cause and effect relationships between cancer and beryllium in drinking water.

#### 4.1.2. Animal

Chronic oral administration of beryllium to animals produced equivocal carcinogenicity results in two studies. In one study, mice and rats treated with drinking water containing 5 ppm beryllium (as beryllium sulfate) had slightly higher incidences of leukemias and grossly observed tumors, but the increases were not statistically significant (Schroeder and Mitchener, 1975a,b). In the other study, male Wistar rats fed diets containing 0, 5, 50, or 500 ppm beryllium as beryllium sulfate for 104 weeks had statistically significant increases in the incidence of reticulum cell sarcoma at the two lowest doses, but no response at the highest dose (Morgareidge et al., 1975). The U.S. EPA (1986b) concluded that this study is suggestive of a carcinogenic response to ingested beryllium, but the lack of response at the high dose and the lack of peer review or publication of the study limits the interpretation as a positive study.

### 4.2. INHALATION EXPOSURES

#### 4.2.1. Human

Infante et al. (1980) conducted a lung cancer mortality study of white males listed in the BCR using a retrospective cohort method. Of the cohort consisting of 421 individuals, 139 had died and 64 had no vital statistics; 15 of the 139 that died had no cause of death listed. In terms of total cancer, 19 deaths were observed vs. 12.41 expected for white males. In terms of lung cancer, 6 deaths were observed 15 or more years after exposure vs. 2.81 expected ( $p < 0.01$ ). However, the study used the NIOSH life table program which results in an 11% excess in the calculated expected number of lung cancer deaths (Wagoner et al., 1980). When the expected lung cancer deaths were adjusted for using the NIOSH program, the  $p$  value was reduced to  $< 0.09$ , questionable or borderline significance. Further analysis of the data from this study revealed a positive correlation for increased cancer and acute (but not chronic) beryllium disease. However, the NIOSH life tables were used for some of the calculations and the results are therefore questionable (U.S. EPA, 1987).

Several epidemiological studies of lung cancer were conducted among beryllium workers from two plants (Bayliss et al., 1971; Bayliss and Lainhart, 1972; Bayliss and Wagoner, 1977; Wagoner et al., 1980; Mancuso, 1970; 1979; 1980). The studies, based on personnel records and social security quarterly earnings reports, were equivocal regarding the carcinogenicity of beryllium. For example, three studies revealed significant increases in observed over expected lung cancer cases in workers who were (a) employed from 1942-1967 and followed for ten additional years ( $p < 0.05$ ) (Bayliss and Wagoner, 1977; Wagoner et al., 1980); (b) employed from 1937-1948 and followed for 30 additional years ( $p < 0.01$ ) (Mancuso, 1980); and (c) combined workers of both plants who were employed from 1942-1948 and followed for an additional 28 years ( $P < 0.01$ ) (Mancuso, 1979). However, the studies were considered to be limited because of methodological constraints and deficiencies such as no correction for smoking (U.S. EPA, 1991a).

The U.S. EPA (1986a) evaluated the total database for the association of lung cancer with occupational exposure to beryllium, and noted several limitations. However, in spite of the limitations of the studies, U.S. EPA (1986a,b) concluded that the results must be considered to be at least suggestive of a carcinogenic risk to humans.

#### 4.2.2. Animal

Inhalation studies have tested the carcinogenic potential of beryllium in various animal species. Table 1 shows that beryllium sulfate causes increased incidences of pulmonary tumors in rats and rhesus monkeys (Vorwald, 1953, 1962, 1968; Vorwald et al., 1955, 1966; Schepers et al., 1957; Reeves and Deitch, 1969). Rats exposed to concentrations of beryllium ranging from 1.8 to 180 mg/m<sup>3</sup> exhibited increased incidences of pulmonary carcinomas that ranged from 20 to 100% (Vorwald 1953; 1962). The animals were exposed 33-38 hours/week for 3 to 24 months. The incidence of lung tumors exhibited a weakly positive correlation with exposure concentration and duration. Schepers et al. (1957) observed a 43% increase in the incidence of pulmonary carcinomas in rats exposed to 32-35 mg/m<sup>3</sup> beryllium 44 hours/week for 6-9 months followed by an

18-month observation period. These investigators identified eight histologically distinct types of tumors in the lungs of exposed rats. The tumors were metastasizing and transplantable. Reeves and Deitch (1969) observed an approximate 100% incidence in lung tumors in rats exposed to 36 mg/m<sup>3</sup> beryllium 35 hours/week for up to 18 months. The studies of these investigators indicated that tumor yield in rats was dependent upon age at exposure rather than on duration of exposure.

Tumor incidences were also increased in rats exposed to beryllium phosphate, beryllium fluoride, and beryl ore (Schepers, 1961; Wagner et al., 1969).

#### **4.3. OTHER ROUTES OF EXPOSURE**

Beryllium is carcinogenic when administered by intratracheal and intravenous injections and implantation into bone. Intratracheal injection of beryllium into rats induced cancer incidences ranging from 0-100%, with latency periods of at least 6 to 9 months (Vorwald and Reeves, 1959; Spencer et al., 1968; 1972; Ishinishi et al., 1980; Groth et al., 1972; 1976; 1980; Groth and MacKay, 1971). Several investigators have induced osteosarcomas in rabbits (Nash, 1950; Dutra and Largent, 1950; Yamaguchi and Katsura, 1963; Sissons, 1950; and others) and mice (Cloudman et al., 1949) with intravenous injection and subperiosteal or intraosseous implantation of beryllium and several of its compounds. The incidence of osteosarcoma ranged from 0-100% by either route of administration, with a latency period of  $\geq 9$  months.

#### **4.4. EPA WEIGHT-OF-EVIDENCE**

##### **4.4.1. Oral**

Not assigned.

##### **4.4.2. Inhalation**

Classification -- B2, probable human carcinogen

Basis -- Inadequate evidence for humans; sufficient evidence for animals (U.S. EPA, 1991a). "Beryllium has been shown to induce lung cancer via inhalation in rats and monkeys and to induce osteosarcomas in rabbits via intravenous or intramedullary injection. Human epidemiology studies are considered to be inadequate."

#### **4.5. SLOPE FACTORS**

##### **4.5.1. Oral**

SLOPE FACTOR: 4.3 (mg/kg/day)<sup>-1</sup>

DRINKING WATER UNIT RISK: 1.2E-4 (µg/L)<sup>-1</sup>

VERIFICATION DATE: 02/01/89 (U.S. EPA, 1991a)

PRINCIPAL STUDY: Schroeder and Mitchener (1975a)

##### **4.5.2. Inhalation**

SLOPE FACTOR: 8.4 (mg/kg/day)<sup>-1</sup>

INHALATION UNIT RISK: 2.4E-3 (µg/m<sup>3</sup>)<sup>-1</sup>

VERIFICATION DATE: 05/04/88 (U.S. EPA, 1991a)

PRINCIPAL STUDY: Wagoner et al. (1980)

## 5. REFERENCES

- ATSDR (Agency for Toxic Substances and Disease Registry). 1988. Toxicological Profile for Beryllium. Prepared by Syracuse Research Corporation under Contract 68-C8-0004. U.S. Public Health Service. ATSDR/TP-88/09.
- Bayliss, D.L. and W.S. Lainhart. 1972. Mortality patterns in beryllium production workers. Presented at the Am. Ind. Hygiene Assoc. Conf. OSHA Exhibit No. 66, Docket No. H005. (Cited in U.S. EPA, 1987a)
- Bayliss, D.L. and J.K. Wagoner. 1977. Bronchogenic cancer and cardio-respiratory disease mortality among white males employed in a beryllium production facility. OSHA Beryllium hearing, 1977, Exhibit 13.F. (Cited in U.S. EPA, 1987a)
- Bayliss, D.L., W.S. Lainhart, L.J. Crally, R. Ligo, H. Ayer and F. Hunter. 1971. Mortality patterns in a group of former beryllium workers. In: Tran. 334rd Ann. Meeting ACGIH, Toronto, Canada. p. 94-107. (Cited in U.S. EPA, 1987a)
- Berg, J.W. and F. Burbank. 1972. Correlations between carcinogenic trace metals in water supply and cancer mortality. *Ann. N.Y. Acad. Sci.* 199: 249-261.
- Budavari, S., M.J. O'Neil, A. Smith and P.E. Heckelman, Eds. 1989. Beryllium. In: *The Merck Index*. Merck & Co., Inc., Rahway, NJ. p. 181.
- Bugryshev, P.F., T.I. Zaikina, Y.I. Moskalev. 1984. Adsorption of beryllium from the rat gastrointestinal tract. *Gig. Tr. Prof. Zabol.* 6: 52-53. (Cited in ATSDR, 1988)
- Clary, J.J., L.S. Bland and H.E. Stokinger. 1975. The effect of reproduction and lactation on the onset of latent chronic beryllium disease. *Toxicol. Appl. Pharmacol.* 33: 214-221.
- Cloudman, A.M., D. Vining, S. Barkulis and J.J. Nickson. 1949. Bone changes following intravenous injections of beryllium. *Am. J. Pathol.* 25: 810-811.
- Constantinidis, K. 1978. Acute and chronic beryllium disease. *Br. J. Clin. Pract.* 32: 127-136. (Cited in U.S. EPA, 1987a)
- Cox, G.E., D.E. Bailey and K. Morgareidge. 1975. Chronic feeding studies with beryllium sulfate in rats. Unpublished report submitted by the Food and Drug Research Laboratories, Inc., to the Aluminum Company of America, Pittsburgh, PA. (Cited in U.S. EPA, 1991a)
- Crowley, J.F., J.G. Hamilton and K.J. Scott. 1949. The metabolism of carrier-free radioberyllium in the rat. *J. Biol. Chem.* 177: 975-984.
- Cullen, M.R., J.R. Kominsky, M.D. Rossman, et al. 1987. Chronic beryllium disease in a precious metal refinery; clinical epidemiologic and immunologic evidence for continuous risk from exposure to low level beryllium fume. *Am. Rev. Respir. Dis.* 135: 201-208.
- Dutra, F.R. and E.J. Largent. 1950. Osteosarcoma induced by beryllium oxide. *Am. J. Pathol.* 26: 197-208.
- Dutra, F.R. 1948. The pneumonitis and granulomatosis peculiar to beryllium workers. *Am. J. Pathol.* 24: 1137.
- Eisenbud, M. and J. Lisson. 1983. Epidemiological aspects of beryllium-induced nonmalignant lung disease: 30-year update. *J. Occup. Med.* 25: 196-202.

- Eisenbud, M., C.F. Berghout and L.T. Steadman. 1948. Environmental studies in plants and laboratories using beryllium: the acute disease. *J. Ind. Hyg.* 30: 281-285.
- Freiman, D.G. and H.L. Hardy. 1970. Beryllium disease: the relation of pulmonary pathology to clinical course and prognosis based on a study of 130 cases from the U.S. Beryllium Case Registry. *Hum. Pathol.* 1: 25-44. (Cited in Kriebel et al., 1988b)
- Furchner, J.E., C.R. Richmond and J.E. London. 1973. Comparative metabolism of radionuclides in mammals: VII. Retention of beryllium in the mouse, rat, monkey and dog. *Health Phys.* 24: 292-300.
- Groth, D.H. and C.R. MacKay. 1971. Chronic pulmonary pathology in rats after intratracheal injection. *Toxicol. Appl. Pharmacol.* 19: 392.
- Groth, D.H., C. Kommiheni and G.R. MacKay. 1980. Carcinogenicity of beryllium hydroxide and alloys. *Environ. Res.* 21: 63-84.
- Groth, D.H., L.P. Scheel and G.R. MacKay. 1972. Comparative pulmonary effects of Be and As compounds in rats. *Lab. Invest.* 26: 447-448.
- Groth, D.H., L. Stehler and G. MacKay. 1976. Interactions of mercury, cadmium, selenium, tellurium, arsenic and beryllium. In: G.F. Nordberg, Ed. *Effects and Dose-Response Relationships of Toxic Metals*. Elsevier Publishing Co., Amsterdam. p. 527-543.
- Guyatt, B.L., H.D. Kay and H.D. Branion. 1933. Beryllium rickets. *J. Nutr.* 6: 313-324.
- Haley, P.J., G.L. Finch, M.D. Hoover and R.G. Cuddihy. 1990. The acute toxicity of inhaled beryllium metal in rats. *Fundam. Appl. Toxicol.* 15: 767-778.
- Hall, T.C., C.H. Wood, J.D. Stoeckle and L.B. Tepper. 1959. Case data from the Beryllium Registry. *Am. Med. Assoc. Arch. Ind. Health* 19: 100-103.
- Infante, P.F., J.K. Wagoner and N.I. Sprince. 1980. Mortality patterns from lung cancer and non-neoplastic respiratory disease among white males in the United States Beryllium Case Registry. *Environ. Res.* 21: 35-43.
- Ishinishi, N., M. Mizunow, T. Inamasu and A. Hisanagel. 1980. Experimental study on carcinogenicity of beryllium oxide and arsenic trioxide to the lung of the rats by intratracheal instillation. *Fukuoka Igaku Zasshi* 71: 19-26. (Cited in U.S. EPA, 1987a)
- Jacobson, S.A. 1933. Bone lesions in rats produced by the substitution of beryllium for calcium in the diets. *Arch. Pathol.* 15: 18-26.
- Kay, H.D. and D.L. Skill. 1934. Prevention and cure of beryllium rickets. *Biochem. J.* 28: 1222-1229.
- Kriebel, D., N.L. Sprince, E.A. Eisen, I.A. Greaves, H.A. Feldman and R.E. Greene. 1988a. Beryllium exposure and pulmonary function: A cross sectional study of beryllium workers. *Br. J. Ind. Med.* 45: 167-173.
- Kriebel, D., J.D. Brain, N.L. Sprince and H. Kazemi. 1988b. The pulmonary toxicity of beryllium. *Am. Rev. Respir Dis.* 137: 464-473.
- Machle, W., E. Beyer and F. Gregorius. 1948. Berylliosis. *Occup. Med.* 5: 671-683.

Mancuso, T.F. 1970. Relation of duration of employment and prior illness to respiratory cancer among beryllium workers. *Environ. Res.* 3: 251-275.

Mancuso, T.F. 1979. Occupational lung cancer among beryllium workers in dusts and disease. In: R. Lemen and J. Dement, Eds. *Proc. Conf. Occup. Exp. to Fibrous and Particulate Dust and Their Extension into the Environment*. Pathrotox Publishers, Inc. (Cited in U.S. EPA, 1987a)

Mancuso, R.f. 1980. Mortality study of beryllium industry workers' occupational lung cancer. *Environ. Res.* 21: 48-55.

Meehan, W.R. and L.E. Smyth. 1967. Occurrence of beryllium as a trace element in environmental materials. *Environ. Sci. Technol.* 1: 839-844.

Morgareidge, K., G.E. Cox and D.E. Bailey. 1975. Chronic feeding studies with beryllium sulfate in rats. Food and Drug Research Laboratories, Inc. Final Report to the Aluminum Company of America, Pittsburgh, Pa. (Cited in U.S. EPA, 1987a)

Morgareidge, K., G.E. Cox, D.E. Bailey and M.A. Gallo. 1977. Chronic oral toxicity of beryllium in the rat. *Toxicol. Appl. Pharmacol.* 41: 204-205.

Nash, P. 1950. Experimental production of malignant tumors by beryllium. *Lancet* 1: 519.

Nishimura, M. 1966. Clinical and experimental studies on acute beryllium disease. *Nagoya J. Med. Sci.* 18: 17-44. (Cited in U.S. EPA, 1987a)

OSHA (Occupational Safety and Health Administration). 1989. Toxic and hazardous substances. Table Z-1. 29 CFR XVII; section 1910.1000.

Parkes, W.R. 1984. *Occupational Lung Disorders*, 2nd ed. Butterworths, London. p. 333. (Cited in Zorn et al., 1988)

Reeves, A.L. 1965. The absorption of beryllium from the gastrointestinal tract. *Arch. Environ. Health* 11: 209-214.

Reeves, A.L. 1979. In: L. Friberg, G.F. Nordberg and V.B. Vouk, Eds. *Handbook of the Toxicology of Metals*. Elsevier/North Holland, Amsterdam. p. 329.

Reeves, A.L. 1986. Beryllium. In: *Toxicology of Metals*, Vol. II., 2nd ed. Elsevier Science Publishing Co., New York, pp.

Reeves, A.L. and D. Deitch. 1969. Influence of age on the carcinogenic response to beryllium inhalation. In: S. Harishima, Ed. *Proc. 16th Internat. Cong. Occup. Health*, Tokyo, Japan. Japan Industrial Safety Association, Tokyo, Japan. p. 651-652. (Cited in U.S. EPA, 1987a)

Reeves, A.L. and A.J. Vorwald. 1967. Beryllium carcinogenesis. II. Pulmonary deposition and clearance of inhaled beryllium sulfate in the rat. *Cancer Res.* 27: 446-451.

Reeves, A.L., D. Deitch and A.J. Vorwald. 1967. Beryllium carcinogenesis. I. Inhalation exposure of rats to beryllium sulfate aerosol. *Cancer Res.* 27: 439-445.

Reeves, A.L., N.D. Krivanek, E.K. Busby and R.H. Swanborg. 1972. Immunity to pulmonary berylliosis in guinea pigs. *Int. Arch. Occup. Environ. Health* 29: 209-220.



- Rhoads, K. and C.L. Sanders. 1985. Lung clearance, translocation and acute toxicity of arsenic, beryllium, cadmium, cobalt, lead, selenium, vanadium, and ytterbium oxides following deposition in rat lung. *Environ. Res.* 36: 359-378.
- Sanders, C.L., W.C. Cannon, G.J. Powers, R.R. Adey and D.M. Meier. 1975. Toxicology of high-fired beryllium oxide inhaled by rodents. *Arch. Environ. Health* 30: 546-551.
- Schepers, G.W.H. 1961. Neoplasia experimentally induced by beryllium compounds. *Prog. Exp. Tumor Res.* 2: 203-224.
- Schepers, G.W.H. 1964. Biological action of beryllium: Reaction of the monkey to inhaled aerosols. *Ind. Med. Surg.* 33: 1-16.
- Schepers, G.W.H. 1971. Lung tumors of primates and rodents. II. *Ind. Med.* 40: 23-31.
- Schepers, G.W.H., T.M. Durkan, A.B. Delahant and F.T. Creedon. 1957. The biological action of inhaled beryllium sulfate: A preliminary chronic toxicity study on rats. *Am. Med. Assoc. Arch. Ind. Health* 15: 32-38.
- Schroeder, H.A. and M. Mitchener. 1975a. Life-term studies in rats; Effects of aluminum, barium, beryllium and tungsten. *J. Nutr.* 105: 421-427.
- Schroeder, H.A. and M. Mitchener. 1975b. Life-term effects of mercury, methyl mercury, and nine other trace metals on mice. *J. Nutr.* 105: 452-458.
- Selivanova, L.M. and T.B. Savinova. 1986. Effects of beryllium chloride and oxide on the sexual function of female rats and development of their progeny. *Gig. Sanit.* 8: 44-46.
- Sendelbach, L.E., A.F. Tryka and H. Witchi. 1989. Progressive lung injury over a one-year period after a single inhalation exposure to beryllium sulfate. *Am. Rev. Resp. Dis.* 139: 1003-1009. (MEDLARS II, TOXLINE)
- Sissons, H.A. 1950. Bone sarcomas produced experimentally in the rabbit using compounds of beryllium. *Acta Unio. Int. Contra. Cancrum.* 7: 171. (Cited in U.S. EPA, 1987a)
- Spencer, J.C., R.H. Hook, J.A. Blumenshine, S.B. McCollister, S.E. Sadek and J.C. Jones. 1968. Toxicological studies on beryllium oxides and beryllium-containing exhaust products. AMRL-7R-68-148. Aeromedical Res. Lab., Wright-Patterson AFB, Dayton, OH. 94. (Cited in U.S. EPA, 1987a)
- Spencer, H.C., S.B. McCollister, J.J. Kociba, C.G. Humiston and G.L. Sparschu. 1972. Toxicological evaluation of beryllium motor exhaust products. AMRL-72-118. Aeromedical Research Lab., Wright-Patterson A.F.B., Dayton, OH. 94 p. (Cited in U.S. EPA, 1987a)
- Sprince, N.L. and H. Kazemi. 1983. Beryllium disease. In: Rom, W., Ed. *Environmental and Occupational Medicine*, 1st ed. Little, Brown, Boston. pp. 481-490. (Cited in Kriebel et al., 1988b)
- Stiefel, T., K. Schulze, H. Zorn and G. Tolg. 1980. Toxicokinetic and toxicodynamic studies of beryllium. *Arch. Toxicol.* 45: 81-92.
- Tepper, L.B., H.L. Hardy and R.J. Chamberlin. 1961. *Toxicity of Beryllium Compounds*. Elsevier, New York, pp. 146-168. (Cited in ATSDR, 1988)
- U.S. EPA (U.S. Environmental Protection Agency). 1986a. Health Assessment Document for Beryllium. Prepared by the Office of Health and environmental Assessment, Environmental Criteria and Assessment Office, Research Triangle Park, NC. External Review Draft. EPA 600-8-84-026B. (Cited in U.S. EPA, 1987a)

U.S. EPA (U.S. Environmental Protection Agency). 1986b. Drinking Water Criteria Document for Beryllium. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the office of Drinking Water, Washington, DC.

U.S. EPA (U.S. Environmental Protection Agency). 1987a. Health Effects Assessment for Beryllium and Compounds. Prepared for Office of Solid Waste and Emergency Response by Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, U.S. EPA, Washington, DC. ECAO-CIN-H113.

U.S. EPA (U.S. Environmental Protection Agency). 1987b. Health Assessment Document for Beryllium. Office of Health and Environmental Assessment, U.S. EPA. (EPA/600/8-84/026F)

U.S. EPA (U.S. Environmental Protection Agency). 1991a. Beryllium. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH.

U.S. EPA (U.S. Environmental Protection Agency). 1991b. Health Effects Assessment Summary Tables. FY-1991 Annual, January, 1991. Office of Research and Development, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, DC. p. A-10.

Vorwald, A.J. 1968. Biologic manifestation of toxic inhalation in monkeys. In: H. Vagtborg, Ed. Use of Nonhuman Primates in Drug Evaluation. Univ of Texas Press, Austin, TX. p. 2. (Cited in U.S. EPA, 1987a)

Vorwald, A.J. 1962. Progress report (unpublished). Grant No. F-253-6. Am. Cancer Soc. (Cited in U.S. EPA, 1987a)

Vorwald, A.J. 1953. Adenocarcinoma in the lung of albino rats exposed to compounds of beryllium. In: Cancer of the Lung - An Evaluation of the Problem. Proc. of the Scientific Session, Annual Meeting, November. Am. Cancer Soc., New York. p. 103-109. (Cited in U.S. EPA, 1987a)

Vorwald, A.J. and A.L. Reeves. 1959. Pathologic changes induced by beryllium compounds. Arch. Ind. Health 19: 190-199.

Vorwald A.J., P.C. Pratt and E.J. Urban. 1955. The production of pulmonary cancer in albino rats exposed by inhalants to an aerosol of beryllium sulfate. Acta. Unio. Int. Cancrum. 11: 735. (Cited in U.S. EPA, 1987a)

Vorwald, A.J., A.L. Reeves and E.J. Urban. 1966. Experimental beryllium toxicology. In: H.E. Stokinger, Ed. Beryllium - Its industrial Hygiene Aspects. Academic Press, New York. pp. 201-234.

Wagner, W.D., D.H. Groth, J.L. Holtz, G.E. Madden and H.E. Stokinger. 1969. Comparative chronic inhalation toxicity of beryllium ores, bertrandite and beryl, with production of pulmonary tumors by beryl. Toxicol. Appl. Pharmacol. 15: 10-29.

Wagoner, J.K., P.F. Infante and D.L. Bayliss. 1980. Beryllium: An etiologic agent in the induction of lung cancer, nonneoplastic respiratory disease and heart disease among industrially exposed workers. Environ. Res. 21: 15-34.

Watanabe, K., S. Shima, S. Tachikawa, et al. 1985. Biototoxicity and beryllium distribution in organs by oral administration of beryllium compounds for long periods. II. Experimental stud

TABLE 1. Pulmonary Carcinoma from Inhalation Exposure of Animals to Beryllium (Page 1 of 2)

Compound/Species	Concentration (mg/m <sup>3</sup> as Be)	Weekly Exposure Time (hours)	Duration of Exposure (months)	Incidence of Pulmonary Carcinoma	Reference
<b>Beryllium sulfate</b>					
Rat	33-35	33-38	12-14	4/8 (females)	Vorwald, 1953
Rat	33-35	33-38	13-18	17/17	Vorwald et al., 1955
Rat	32-35	44	6-9, followed by 18-month observation	58/136	Schepers et al., 1957
Rat	55	33-38	3-18	55/74	Vorwald, 1962
Rat	180	33-38	12	11/27	Vorwald, 1962
Rat	18	33-38	3-22	72/103	Vorwald, 1962
Rat	18	33-38	8-21	31/63	Vorwald, 1962
Rat	18	33-38	9-24	47/90	Vorwald, 1962
Rat	18	33-38	11-16	9/21	Vorwald, 1962
Rat	1.8-2.0	33-38	8-21	25/50	Vorwald, 1962
Rat	1.8-2.0	33-38	9-24	43/95	Vorwald, 1962
Rat	1.8-2.0	33-38	13-16	3/15	Vorwald, 1962
Rat	21-42	33-38	18	almost all	Vorwald et al., 1966
Rat	2.8	33-38	18	13/21	Vorwald et al., 1966
Rat	34	35	13	43/43 (females)	Reeves et al., 1967
Rat	36	35	3	19/22 (both sexes)	Reeves and Deitch, 1969
Rat	36	35	6	33/33 (both sexes)	Reeves and Deitch, 1969
Rat	36	35	6	33/33 (both sexes)	Reeves and Deitch, 1969
<b>Beryllium sulfate</b>					
Rat	36	35	9	15/15 (both sexes)	Reeves and Deitch, 1969
Rat	36	35	12	21/21 (both sexes)	Reeves and Deitch, 1969
Rat	36	35	18	13/15 (both sexes)	Reeves and Deitch, 1969

TABLE 1. Pulmonary Carcinoma from Inhalation Exposure of Animals to Beryllium (Page 2 of 2)

Compound/Species	Concentration (mg/m <sup>3</sup> as Be)	Weekly Exposure Time (hours)	Duration of Exposure (months)	Incidence of Pulmonary Carcinoma	Reference
Rhesus monkey	35-200	42	8	0/4 (females)	Schepers, 1964
Rhesus monkey	38.8	15	36+	8/11	Vorwald, 1964
Guinea pig	35	NR <sup>a</sup>	12	0	Schepers, 1961
Guinea pig	36	35	12	2/20	Schepers, 1971
Guinea pig	3.7-30.4	35	18-24	0/58	Reeves et al., 1972
<b>Beryllium phosphate</b>					
Rat	32-35	NR <sup>a</sup>	1-12	35-60/170 <sup>b</sup>	Schepers, 1961
Rat	227	NR <sup>a</sup>	1-12	7/40 <sup>b</sup>	Schepers, 1961
Rhesus monkey	200	42	8	0/4 (females)	Schepers, 1961
Rhesus monkey	1100	42	8	0/4 (females)	Schepers, 1964
Rhesus monkey	8300	42	8	0/4 (females)	Shepers, 1964
<b>Beryllium fluoride</b>					
Rat	9	NR <sup>a</sup>	6-15	10-20/200	Schepers, 1961
Rhesus monkey	180	42	8	0/4 (females)	Schepers, 1964
<b>ZnBEMnSiO<sub>3</sub></b>					
Rat	700	NR <sup>a</sup>	9	4-20/220 <sup>b</sup>	Schepers, 1961
Rabbit	700	NR <sup>a</sup>	24	0	Schepers, 1961
Guinea pig	700	NR <sup>a</sup>	22	0	Schepers, 1961
<b>Beryl ore</b>					
Rat	620	30	17+	18/19	Wagner et al., 1969
Hamster	620	30	17+	0/48	Wagner et al., 1969
Squirrel monkey	620	30	17+	0/12	Wagner et al., 1969

<sup>a</sup>NR = Not reported

<sup>b</sup>Number of tumors/Number of animals exposed

**TOXICITY SUMMARY FOR  
MANGANESE**

May 1995

Prepared By

Andrew Francis and Carol Forsyth  
Chemical Hazard Evaluation Group  
Biomedical and Environmental Information Analysis Section  
Health Sciences Research Division  
Oak Ridge National Laboratory\*  
Oak Ridge, Tennessee

Prepared for

U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

Contracting Officer's Representative  
Robert L. Muhly  
Technology Demonstration and Transfer Branch  
Environmental Technology Division  
U.S. ARMY ENVIRONMENTAL CENTER  
Aberdeen Proving Ground, Maryland 21010-5401

---

\*Managed by Lockheed Martin Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400

## TOXICITY SUMMARY UPDATE

This report is an update of the Toxicity Summary for Manganese (CAS Registry No. 7439-96-5). The original summary for this chemical was submitted in June 1991. The update was performed by incorporating any new human health toxicity data published since the original submittal of the report. Pertinent pharmacokinetic, toxicologic, carcinogenic, and epidemiologic data were obtained through on-line searches of the TOXLINE database from 1992 through April 1995. In addition, any changes to EPA-approved toxicity values (reference doses, reference concentrations, or cancer slope factors) from the Integrated Risk Information System (IRIS) (current as of May 1995) and/or the Health Effects Assessment Summary Tables, Annual FY-94; July Supplement No. 1; and November Supplement No. 2) for this chemical were incorporated in this update.

## EXECUTIVE SUMMARY

Manganese is an essential trace element in humans, which can elicit a variety of serious toxic responses upon prolonged exposure to elevated concentrations either orally or by inhalation. The central nervous system is the primary target. Initial symptoms are headache, insomnia, disorientation, anxiety, lethargy and memory loss. These symptoms progress with continued exposure and eventually include motor disturbances, tremors and difficulty in walking, similar to symptoms seen in Parkinsonism. These motor difficulties are most often irreversible. Based on human epidemiological studies, 0.8 mg/kg/day for drinking water exposure and 0.34 mg/m<sup>3</sup> in air for inhalation exposure have been estimated as lowest-observed-adverse-effect levels (LOAELs) for central nervous system effects.

Effects on reproduction (decreased fertility, impotence) have been observed in humans with inhalation exposure and in animals with oral exposure at the same or similar doses that initiate the central nervous system effects. An increased incidence of coughs, colds, dyspnea during exercise, bronchitis and altered lung ventilatory parameters have also been seen in humans and animals with inhalation exposure. A possible effect on the immune system may account for some of the respiratory symptoms.

Because of the greater bioavailability of manganese from water, separate reference doses (RfD) for water and diet were calculated. A chronic (U.S. EPA, 1995) and subchronic RfD (U.S. EPA, 1994) for drinking water of 0.005 mg/kg/day has been calculated by EPA from a human no-observed-adverse-effect level (NOAEL) of 0.005 mg/kg/day; the NOAEL was determined from an epidemiological study of human populations exposed for a lifetime to manganese concentrations in drinking water ranging from 3.6 to 2300 µg/L (Kondakis, et al., 1989). A chronic (U.S. EPA, 1995) and subchronic RfD (U.S. EPA, 1994) of 0.14 mg/kg/day for dietary exposure has been calculated by the EPA from a human NOAEL of 0.14 mg/kg/day, which was determined from a series of epidemiological studies (Schroeder et al., 1966; WHO, 1973; NRC, 1989). Large populations with different concentrations of manganese in their diets were examined. No adverse effects that were attributable to manganese were seen in any of these groups. For both the drinking water and dietary values, the RfD was derived from these studies without uncertainty factors since manganese is essential in human nutrition and the exposure of the most sensitive groups was included in the populations examined. U.S. EPA (1995) indicates that the chronic RfD values are pending change.

A reference concentration (RfC) of 0.05 µg/m<sup>3</sup> (U.S. EPA, 1995) for chronic inhalation exposure was calculated from a human LOAEL of 0.05 mg/m<sup>3</sup> for impairment of neurobehavioral function from an epidemiological study by Roels et al. (1992). The study population was occupationally exposed to airborne manganese dust with a median concentration of 0.948 mg/m<sup>3</sup> for 0.2 to 17.7 years with a mean duration of 5.3 years. Neurological examinations, psychomotor tests, lung function tests, blood tests and urine tests were used to determine the possible effects of exposure. The LOAEL was derived from an occupational-lifetime integrated respirable dust concentration of manganese dioxide expressed as mg manganese/m<sup>3</sup> x years. Confidence in the inhalation RfC is rated medium by the EPA.

There are some conflicting data on possible carcinogenesis following injections of manganese chloride and manganese sulfate in mice. However, the EPA weight-of-evidence classification is: D, not classifiable as to human carcinogenicity based on no evidence in humans and inadequate evidence in animals (U.S. EPA, 1995).

## 1. INTRODUCTION

Manganese (CAS registry number 7439-96-5) makes up about 0.10% of the earth's crust and is the 12th most abundant element. It can exist in oxidation states from -3 to +7, the most common being +4 in the chemical form of manganese dioxide (Keen and Leach, 1988). The oxides and peroxides are used in industry as oxidizers, and the metal is used for manufacturing metal alloys to increase hardness and corrosion resistance. In living systems, manganese is an essential element that is found most often in the +2 valence (Keen and Leach, 1988; Stokinger, 1981).

Normal nutritional requirements of manganese are satisfied through the diet, which is the normal source of the element, with minor contributions from water and air (U.S. EPA, 1984). The National Research Council (NRC, 1989) recommends a dietary allowance of 2 to 5 mg/day for a safe and adequate intake of manganese for an adult human. Toxic exposures occur largely due to particulate material in the air from mining and manufacturing activity.

## **2. METABOLISM AND DISTRIBUTION**

### **2.1. ABSORPTION**

Intestinal absorption has been estimated to be between 3 and 10% of the amount of manganese ingested and is a multiple step process similar to and involving some of the same binding sites as in iron absorption (U.S. EPA, 1995). Experiments with isolated rat intestine indicate that manganese absorption is carrier-mediated with saturation occurring at 0.5 mM (Testolin et al., 1993). The absorption of manganese by inhalation depends on the particle size. The larger particles are cleared from the respiratory tract by the cilia and swallowed, whereas, the fine particles (< 2.5 microns) are deposited in the lungs and must be cleared by absorption into the blood and lymph circulation (U.S. EPA, 1995). It is estimated that 60 to 70% of the inhaled particles are eventually swallowed (Stokinger, 1981).

### **2.2. DISTRIBUTION**

Once absorbed, manganese is transported to organs rich in mitochondria (liver, pancreas and pituitary in particular) where it is rapidly concentrated. Accumulation of manganese in the central nervous system following an intraperitoneal or intramuscular injection occurs slowly reaching a maximum in about 30 days. Distribution is homogeneous in the brain with lower concentrations in the spinal cord. The average turnover time in the central nervous system is reported to be about 110 days following intraperitoneal injection and about 55 days for intramuscular injection (Stokinger, 1981).

### **2.3. METABOLISM**

Manganese does not undergo metabolism; it is absorbed and excreted unchanged. However, manganese is an essential trace element and is involved as an activator or cofactor with a number of diverse enzymes involved with energy metabolism, digestion, and lipid and protein metabolism (Orten and Neuhaus, 1975).

### **2.4. EXCRETION**

The normal adult body pool of about 20 mg is maintained by the liver and the excess manganese is excreted into the intestine via the bile. This control is achieved with a daily intake of 10 to 20% of the total pool, thus relatively large amounts are handled by this mechanism. The normal urinary level of manganese averages about 2.75 µg/L with a range of about 1.0 to 8.0 µg/L. Urinary levels over 10 µg/L are indicative of manganese overexposure (Stokinger, 1981).

## **3. NONCARCINOGENIC HEALTH EFFECTS**

### **3.1. ORAL EXPOSURES**

#### **3.1.1. Acute Toxicity**

##### **3.1.1.1. Human**

Information on the acute oral toxicity of manganese in humans was unavailable.



### 3.1.1.2. Animal

Due to the control exerted by mammals over manganese absorption and excretion, acute oral toxicity is observed only after relatively large doses. Several LD<sub>50</sub> values have been calculated. In one oral study using Sprague-Dawley rats, manganese dichloride tetrahydrate was given by stomach tube and the animals were observed for 14 days. The LD<sub>50</sub> was calculated to be 1484 mg/kg or 7.5 mmole/kg. The manganese concentrations in liver, kidney, spleen, heart, testes, brain and blood of the surviving animals returned to control values within the 14 day period. (Holbrook et al., 1975).

Other oral values include an LD<sub>50</sub> of 1715 mg/kg for manganese dichloride in mice and 3730 mg/kg for manganese<sup>2+</sup> acetate in rats (Lewis and Sweet, 1984). Potassium permanganate, a strong oxidizing agent, is an irritant to mucosal tissues, is hemolytic and damages capillaries regardless of the route. An oral LD<sub>50</sub> of 1090 mg/kg has been determined for potassium permanganate in rats (Stokinger, 1981).

However, rats maintained on manganese-deficient diets for 21 days had higher plasma ammonia and lower plasma urea concentrations in association with lowered hepatic manganese concentrations and decreased arginase activity as compared to rats on diets containing 48 µg Mn/g diet (Brock et al., 1994).

### 3.1.2. Subchronic Toxicity

#### 3.1.2.1. Human

A number of epidemiological studies have been performed that have documented the response of human populations to subchronic or chronic exposure to elevated manganese concentrations. Signs of toxicity may appear within months and continue for years. Initial signs of manganese toxicity usually include headache, disorientation, speech disturbances, memory loss and acute anxiety. Prompt removal of the affected person from the source of manganese exposure usually results in reversal of most of the symptoms; however, the symptoms will increase and eventually become irreversible if the individual continues to be exposed to high manganese concentrations (Keen and Leach, 1988). See section 3.1.3 for discussions of individual studies.

#### 3.1.2.2. Animal

A decrease in brain amines was observed in a study on the effects of manganese chloride on brain chemistry. Male Sprague-Dawley rats were given 0.1 or 1.0 mg manganese/mL in drinking water for eight months after which the brains were removed, dissected and analyzed for various brain amines. Effects were seen with both doses. Decreases in the following amines were observed: dihydroxyphenylacetic, noradrenaline, homovanillic acid, 5-hydroxyindolacetic acid, noradrenaline and serotonin.

In a similar study, rats were given 0.54 mg MnCl<sub>2</sub>·5H<sub>2</sub>O/mL in drinking water for 90 days (Subhash and Padmashree, 1991). Manganese accumulation in various brain regions was two- to three-fold that of controls. Also observed in various brain regions were inhibition of dopamine β-hydroxylase and monoamine oxidase, decreased and increased dopamine levels, and increased serotonin.

Feedlot calves fed a diet supplemented with 50 ppm zinc methionine plus 40 ppm manganese methionine for 34 days had better response to disease challenge than control (no supplement) animals or calves supplemented with the oxide forms of zinc and manganese. Calves fed the organic form of the metals had lower temperatures, higher feed intake, and greater body weight gain following challenge with infectious bovine rhinotracheitis virus when compared to control or inorganic zinc and manganese supplemented calves (Chirase, et al., 1994).

### 3.1.3. Chronic Toxicity

#### 3.1.3.1. Human

An epidemiological study by Schroeder et al. (1966) on normal diets in the United States, England and Holland demonstrated that the average daily intake of manganese ranged from about 2.3 to 8.8 mg/day. Certain other diets (vegetarian) were possibly higher in manganese, but all were considered safe for chronic human consumption. In another portion of the study, patients were given 9 mg manganese/day as manganese citrate for many months. Assuming the average dietary intake of 2.5 mg/day, the total manganese intake was about 11.5 mg/day. No signs of toxicity were seen in either part of the study.

The World Health Organization reviewed the above study and other dietary information and concluded that 2 to 3 mg manganese/day is adequate for adults and 8 to 9 mg/day is safe (WHO, 1973). The Food and Nutrition Board of the National Research Council also examined the available evidence and determined 10 mg manganese/day to be safe. They chose an adequate and safe intake of manganese to be 2 to 5 mg/day for adults (NRC, 1989).

Sixteen cases of manganese toxicity from drinking contaminated water were reported in a study by Kawamura et al. (1941). The symptoms included lethargy, increased muscle tonus, tremor and mental disturbances. Children were affected less than the elderly. The drinking water was estimated to contain at least 28 mg manganese/L, which would be equivalent to an intake of 0.8 mg/kg/day (56 mg/day) for a 70 kg adult drinking 2 L of water/day.

Kondakis et al. (1989) conducted an epidemiological study in three areas of northwestern Greece containing maximum manganese concentrations of 14.6, 252.6 and 2300  $\mu\text{g/L}$  in drinking water. Mean concentrations of manganese in hair samples were 3.51, 4.49 and 10.99  $\mu\text{g/g}$  dry weight from the areas with low, medium and high manganese concentrations, respectively, in drinking water. The concentration in whole blood was the same for all three areas. The individuals in the study were given a neurological examination designed to test for the presence and severity of 33 different symptoms associated with manganese central nervous system toxicity. The combined average scores for both sexes were 2.7, 3.9 and 5.2 for the low, medium and high concentrations respectively. Although this effect was not large, the score for the high concentration was significantly higher than the score recorded for the low concentration. The experiment was criticized for the small numbers of individuals tested, the lack of scatter data, and the lack of dietary data. Nevertheless, the experiment established an uncertainty about extrapolating dietary risk factors to drinking water without considering the possibility of differential absorption (U.S. EPA, 1995).

In addition to the central nervous system effects, an iron-responsive anemia is commonly found with orally-induced manganese toxicity (Keen and Leach, 1988).

#### 3.1.3.2. Animal

A number of studies have shown that biochemical changes occur in the brains of rodents following the administration of about 1 mg/mL manganese dichloride tetrahydrate in drinking water (Lai et al., 1981; Leung et al., 1981; see also the discussion in section 3.1.2.2). Various forms of manganese in the diet of mice affect biogenic amine levels in the brain. Mice were fed 2 g Mn/kg in the form of  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ ,  $\text{Mn}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}$ ,  $\text{MnCO}_3$ , or  $\text{MnO}_2$  for 12 months (Komura and Sakamoto 1992). Manganese dioxide feeding resulted in lowered dopamine levels in the corpus striatum, hypothalamus, and midbrain. Accumulation of manganese in the brain correlated with both reduced dopamine levels in the hypothalamus and suppression of motor activity in the manganese acetate group.

A study of more relevance to humans was conducted by Gupta et al. (1980). Neurological symptoms, including muscular weakness and rigidity of the lower limbs, were seen in a group of 4 rhesus monkeys after 18 months treatment with 6.9 mg manganese/kg/day (given as manganese dichloride tetrahydrate). Degenerated

neurons in the substantia nigra and scanty neuromelanin granules in pigmented cells were reported upon histological analysis.

Lambs on a high manganese diet developed a reduction in hemoglobin. This observation is consistent with the anemia seen in humans and indicates that large amounts of manganese can interfere with intestinal iron absorption (Stokinger, 1981).

### **3.1.4. Developmental and Reproductive Toxicity**

#### **3.1.4.1. Human**

Information on developmental and reproductive toxicity of manganese in humans following oral exposure was unavailable.

#### **3.1.4.2. Animal**

Groups of four male adult rhesus monkeys were given daily doses of 0 or 25 mg manganese chloride tetrahydrate/kg (6.94 mg manganese/kg) by oral gavage for 18 months. The testes of the treated monkeys exhibited interstitial edema and degeneration of the seminiferous tubules (Murthy et al., 1980; U.S. EPA, 1989).

Other studies measured the effect of manganese chloride on various brain enzyme activities. Rats were exposed to 0, 1, or 10 mg/mL in the drinking water from conception onwards. Both Na-K-ATPase and Mg-ATPase activities increased in most brain regions in treated rats as compared to controls between postnatal days 5 and 20 but were decreased by day 60. These transient enzyme changes occurred despite a dose-dependent increase in brain manganese levels (Lai, et al., 1991). No differences were observed for brain monoamine oxidase activity (Leung, et al., 1993).

Pregnant Long-Evans rats were fed diets containing 0, 400, 1100 or 3550 ppm manganese from day 2 of gestation. The F<sub>1</sub> offspring were fed the same diet until they were up to 225 days old. Decreased serum testosterone was observed in 100 day old offspring exposed to 400 ppm manganese. Decreased fertility was seen upon mating the offspring receiving the 3550 ppm dose (Laskey et al., 1982).

To determine the effect of excess aluminum on manganese deficiency in developing mice, dams were fed manganese deficient diets with or without high aluminum throughout gestation and lactation. Offspring exposed to manganese deficient diets had growth retardation and reduced forelimb and hindlimb grip strength as compared to controls on postnatal day 24. These effects were exacerbated by high aluminum (Golub, et al., 1991).

### **3.1.5. Reference Dose**

#### **3.1.5.1. Subchronic: drinking water**

ORAL RfD: 0.005 mg/kg/day (U.S. EPA, 1994)

UNCERTAINTY FACTOR: 1

NOAEL: 0.005 mg/kg/day

#### **Subchronic: diet**

ORAL RfD: 0.14 mg/kg/day (U.S. EPA, 1994)

UNCERTAINTY FACTOR: 1

PRINCIPAL STUDIES: The same studies and comments apply for both the subchronic and chronic RfD derivations. See section 3.1.5.2.

### 3.1.5.2. Chronic: drinking water

ORAL RfD: 0.005 mg/kg/day (U.S. EPA, 1995)

UNCERTAINTY FACTOR: 1

MODIFYING FACTOR: 1

NOAEL: 0.005 mg/kg/day

CONFIDENCE:

Study: Low-to-medium

Data Base: Medium-to-low

RfD: Medium-to-low

VERIFICATION DATE: 09/22/92

PRINCIPAL STUDY: Kondakis et al., 1989.

### Chronic: diet

ORAL RfD: 0.14 mg/kg/day (U.S. EPA, 1995)

UNCERTAINTY FACTOR: 1

MODIFYING FACTOR: 1

NOAEL: 0.14 mg/kg/day

LOAEL: none

CONFIDENCE:

Study: High

Data Base: Medium

RfD: Medium

VERIFICATION DATE: 09/22/92

PRINCIPAL STUDIES: Schroeder et al., 1966; WHO, 1973; NRC, 1989.

COMMENTS: Because of the greater bioavailability of manganese from water, a separate RfD for water was calculated. The major advantage of the Kondakis et al., (1989) study is that it examined a sensitive human subpopulation exposed for a lifetime; however, confidence is low in the study because of lack of data on concurrent dietary manganese. The dietary RfD is based on a composite of data from the above three references. The uncertainty factor of 1 was applied because the information used to determine the RfD was taken from large adult human populations and the most sensitive subpopulation was represented within the group. Humans exert an efficient homeostatic control over manganese. It is important to recognize that manganese is an essential human nutrient (U.S. EPA, 1995). The most current IRIS records (U.S. EPA, 1995) indicate that the RfDs are pending change.

## 3.2. INHALATION EXPOSURES

### 3.2.1. Acute toxicity

#### 3.2.1.1. Human

The inhalation of manganese oxide fumes, such as could be produced from welding, can result in chills, fever, sweating, nausea, and cough. These influenza-like symptoms begin four to 12 hours after exposure and diminish after 24 hours. This "metal fume fever" usually causes no permanent damage unless exposure is continually repeated (Proctor et al., 1988).

#### 3.2.1.2. Animal

Intratracheal injections of manganese oxides (particle size  $<3 \mu\text{m}$ ) caused congestion, pulmonary edema and histological changes in the lungs of young rats. The higher oxides were more toxic (Stokinger, 1981).

Monkeys exposed to high concentrations of manganese in an aerosol exhibited alternating periods of sudden movement followed by torpor, nervousness, severe tremor, alternate flexion and extension of the upper

limbs, yawning, and cyanosis. The monkeys returned to normal three weeks after exposure, but more severe symptoms, including uncertain gait and paresis, appeared in five months (Stokinger, 1981).

Groups of three male and female Sprague-Dawley rats were exposed 6 hours/day, 5 days/week for 2 weeks to 0, 43, 82 or 138 mg manganese/m<sup>3</sup> (given as manganese dioxide). Dose-related increases in the incidence and severity of pneumonitis and wet weight of the lungs were seen. Granulomas were seen in the 138 mg/m<sup>3</sup> exposure group (Shiotsuka, 1984).

Several animal studies reviewed in U.S. EPA (1995) demonstrate probable immunosuppression following exposure to manganese tetroxide and *Streptococci*, *Enterobacter* or *Klebsiella*. In one such study, DC-1 mice were exposed to various levels of manganese tetroxide for two hours followed by exposure to *Streptococcus pyogenes* aerosol for 20 minutes. The incidence of mortality was related to the dose of manganese. Prior immunity to *Streptococci* did not counteract the effects of manganese tetroxide inhalation and consequent *Streptococci* infection (Adkins et al, 1980).

### 3.2.2. Subchronic Toxicity

#### 3.2.2.1. Human

Most human studies on manganese toxicity are epidemiological studies on populations exposed to manganese compounds in dust particles. Individuals in these studies were exposed to manganese for less than one year to more than 20 years. The primary difference between subchronic and chronic central nervous system symptoms is the reversibility of the early subchronic symptoms.

There is an overlap between the inhalation and oral routes since manganese contained in larger particle sizes (greater than about 2.5 µm) is deposited in the tracheobronchial and extrathoracic regions and is cleared by the action of the cilia into the gastrointestinal tract. It is not surprising that the same central nervous system symptoms are seen with both routes (See section 3.1.2.1.). Respiratory system effects, nasal irritation, colds, bronchitis and pneumonia are increased in exposed populations and these symptoms can be seen following subchronic and chronic exposures (See section 3.2.3. for individual experiments).

#### 3.2.2.2. Animal

Dose-dependent hyperplasia of the peribronchial tissue, pulmonary emphysema and atelectasis, exudate in the bronchioles, and thickening of the alveolar wall were observed in rhesus monkeys exposed 22 hours/day for 10 months to manganese at concentrations of 0, 0.7 or 3.0 mg/m<sup>3</sup> (given as manganese dioxide dust) (Suzuki et al., 1978).

### 3.2.3. Chronic Toxicity

#### 3.2.3.1. Human

A study was conducted by Roels et al. (1987) in which 141 males occupationally exposed to manganese dioxide, tetroxide, sulfate, carbonate and nitrate were compared to a group of 104 males who were not occupationally exposed to these compounds. The groups were matched in background environmental factors, work load and shift responsibilities. The duration of employment ranged from 1 to 19 years with a mean of 7.1 years. A higher frequency of coughs, dyspnea during exercise, episodes of acute bronchitis and altered lung ventilatory parameters were found in the exposed group. Significant alterations were also found in visual reaction time, audioverbal short-term memory, eye-hand coordination, and hand steadiness in the exposed group. A LOAEL of 0.34 mg/m<sup>3</sup> was determined from these observations.

A more recent study by Roels et al. (1992) examined 92 male workers exposed to manganese dioxide dust in a battery plant. Exposure time ranged from 0.2-17.7 years (mean, 5.3 years) and exposure concentrations of respirable and total dust were 0.215 mg/m<sup>3</sup> and 0.948 mg/m<sup>3</sup>, respectively. No differences were found in the

manganese-exposed workers for respiratory or neurological symptoms, spirometric measurements, hormone levels, or calcium metabolism as compared to unexposed controls. However, visual reaction time, hand-eye coordination, and hand steadiness were significantly impaired.

A group of 60 welders from three separate plants who were exposed to manganese fumes were studied by Chandra et al. (1981). The mean concentrations of manganese were 0.31, 0.57 and 1.74 mg/m<sup>3</sup> measured in the air from plant 1, 2, and 3 respectively. Frequent colds, cough and fever were reported by the individuals from plant 1; workers from all three plants reported insomnia. Signs of neurological effects measured by "brisk, deep reflexes" in the legs and/or arms were seen in 25, 50 and 45% of workers in plant 1, 2 and 3, respectively. Tremors were also observed in one worker in plant 1 and four workers in plant 2. Increased urinary manganese and serum calcium levels were also seen in workers from all plants. A LOAEL of 0.11 mg/m<sup>3</sup> was determined from the mean exposure at plant 1.

A similar study was reported by Iregren (1990) in which 15 workers from each of two Swedish foundries were studied for manganese exposure. The inhalation exposure concentration varied from 0.02 to 1.4 mg/m<sup>3</sup> and the time of exposure varied from 1 to 35 years. A reference group of two unexposed workers from the same geographic area was matched (age, type of work) to each exposed worker. Neurobehavioral function was evaluated by eight computerized tests from the Swedish Performance Evaluation System and two manual dexterity tests. Significant differences were found between the exposed and unexposed groups in simple reaction time and manual dexterity (finger tapping speed). A concentration-response relationship, however, could not be established. A LOAEL of 0.09 mg/m<sup>3</sup> was determined for the neurological effects.

Alloy workers with an average of 16.7 years of work in a ferromanganese and silicomanganese alloy facility were compared to matched controls for symptom reporting and on a series of nervous system function tests (Mergler, et al., 1994). Respirable manganese levels in the alloy plant at stationary sampling sites averaged 0.122 mg/m<sup>3</sup>. Alloy workers had significantly higher manganese blood levels than the control group (1.12 µg/100 mL vs 0.72 µg/100 mL). Symptoms reported more frequently for the alloy workers included fatigue, adverse emotional state, memory loss, attention difficulties, nightmares, sweating without physical exertion, difficulty maintaining an erection, and tinnitus. Overall the alloy workers also performed more poorly than the controls on motor function tests, optic spatial organization of movement, dynamic organization, cognitive flexibility, and olfactory perception threshold.

Respiratory effects, including an increased incidence of colds, bronchitis and pneumonia, have been reported in at least four other human studies. It is believed unlikely that exposure to manganese is solely responsible for the increased respiratory symptoms. A decrease in resistance to infectious agents, possibly as a result of a weakened immune response, is probably a contributing factor (U.S. EPA, 1995).

### **3.2.3.2. Animal**

Groups of 4 female rhesus monkeys were exposed to 0 or 30 mg/m<sup>3</sup> manganese 6 hours/day, 5 days/week for 2 years. Significantly decreased dopamine concentrations were observed in the caudate and globus pallidus regions of the brains of treated monkeys. No behavioral abnormalities were noted during routine (cage side) observations. Neurobehavioral dysfunction was not specifically tested (Bird et al., 1984).

### **3.2.4. Developmental and Reproductive Toxicity**

#### **3.2.4.1 Human**

The same population of male factory workers studied by Roels (see section 3.2.3.1.) was also studied by Lauwerys et al. (1985) for reproductive effects. The results of a fertility questionnaire indicated that fewer children were born to workers exposed to manganese dust between the ages of 16-25 and 26-35. The same LOAEL of 0.34 mg/m<sup>3</sup> was calculated for reproductive effects.

#### 3.2.4.2. Animal

Decreased body weight and impaired neurobehavioral performance (balance and coordination) were seen in the offspring of female HA/ICR mice that were exposed to 48.9 mg manganese/m<sup>3</sup> 7 hours/day, 5 days/week. Exposure was initiated 4 months prior to breeding and continued through day 18 of gestation. Similar neurobehavioral responses were obtained from offspring of unexposed mice which were fostered to manganese-exposed females during lactation (Massaro et al., 1980).

#### 3.2.5. Reference Concentration/Dose

##### 3.2.5.1. Subchronic

A subchronic RfC for manganese has not been derived (U.S. EPA, 1994).

##### 3.2.5.2. Chronic

INHALATION RfC: 0.00005 mg/m<sup>3</sup> (U.S. EPA, 1995)

UNCERTAINTY FACTOR: 1000

MODIFYING FACTOR: 1

NOAEL: none

LOAEL: 0.05 mg/m<sup>3</sup>

CONFIDENCE:

Study: Medium

Data Base: Medium

RfC: Medium

VERIFICATION DATE: 09/23/93

PRINCIPAL STUDIES: Roels et al., 1987, 1992

COMMENTS: The LOAEL was derived from an occupational-lifetime integrated respirable dust concentration of manganese dioxide expressed as mg manganese/m<sup>3</sup> x years. Effects were based on impairment of neurobehavioral function as a result of occupational exposure to manganese dust. The uncertainty factor accounts for the use of a LOAEL (10), the protection of sensitive individuals (10) and data base limitations reflecting both the less-than-chronic exposure time and the lack of developmental data, as well as potential but unquantified differences in the toxicity of different forms of manganese (10).

#### 3.3. OTHER ROUTES OF EXPOSURE

##### 3.3.1. Acute Toxicity

###### 3.3.1.1. Human

Taylor and Price (1982) reported a clinical case of acute pancreatitis that resulted from hemodialysis of a patient with a solution contaminated with manganese. Symptoms, which appeared within one hour from the start of dialysis, included severe vomiting, epigastric pain, increased heart rate and increased blood pressure. The dialysis was discontinued after 30 minutes. The dialysate was found to contain 715 µmol/L manganese sulfate. The diagnosis of acute pancreatitis was made the next day (day 2). The patient suffered from a high fever, persistent abdominal pain, weakness and a drop in serum calcium from day 2 through day 4. A high leukocyte count persisted past day 14 after which it returned to normal. The serum manganese levels were found to be 4.55, 1.71 and 0.65 µmol/L on days 2, 3 and 6, respectively. The patient was discharged free from abdominal pain and on a normal diet 31 days after manganese exposure.

### **3.3.1.2. Animal**

A number of experiments have indicated that manganese is considerably more toxic by injection. LD<sub>50</sub> values of 121 and 255 mg/kg in mice were determined for manganese dichloride given by intraperitoneal and intramuscular injections, respectively. LD<sub>50</sub> values for the tetrahydrate are 190 mg/kg for intraperitoneal injection in mice and 138 mg/kg for intraperitoneal injection in rats. The latter value can be compared to the LD<sub>50</sub> of 1484 mg/kg for oral exposure in rats discussed in section 3.1.1.2 (Lewis and Sweet, 1984).

Histological changes in the lungs of rats have been reported to occur within minutes after the injection of 40 mg/kg of manganese dioxide. An injection of manganese dioxide followed by a like injection of manganese dichloride resulted in severe congestion and pulmonary edema that was often fatal (Stokinger, 1981).

Brain damage has been induced in rats by direct injection of manganese into the brain (Sloot, et al., 1994). Intrastriatal injections of manganese chloride produced dose-dependent (0.05-0.8 µmol) dopamine depletion and time-dependent (0.4 µmol) calcium accumulation.

Sprague-Dawley or Osborne-Mendel rats injected intraperitoneally with 40 mg manganese/kg (given as manganese dichloride) became hyperglycemic within two hours. The increase in blood sugar was accompanied by a decrease in plasma insulin. Manganese was rapidly concentrated in the liver (45 minutes) and the pancreas (15 minutes). Blood sugar values returned to control levels within eight hours after the injection (Baly et al., 1985).

Intravenous injection of MnCl<sub>2</sub> to male New Zealand white rabbits caused a dose-responsive decrease in mean arterial pressure (3-100 µM/kg), an increase in heart rate (0.3-100 µM/kg), and alterations in the electrocardiogram. These effects were not attenuated by coadministration of CaCl<sub>2</sub> (Lee, 1993).

### **3.3.2. Subchronic Toxicity**

#### **3.3.2.1 Human**

Information on the subchronic toxicity of manganese in humans by other routes of exposure was unavailable.

#### **3.3.2.2 Animal**

Intraperitoneal injections to mice of 5 mg manganese chloride/kg/d, 5 d/week, for 9 weeks did not alter the cholinergic muscarinic receptor density or the dissociation constant of <sup>3</sup>H-quinuclidinyl benzilate in the striatum, frontal cortex, or hippocampus brain regions (Villalobos, et al., 1994).

### **3.3.3. Chronic Toxicity**

Information on the chronic toxicity of manganese in humans or animals by other routes of exposure was unavailable.

### **3.3.4. Developmental Toxicity**

#### **3.3.4.1 Human**

Information on the developmental toxicity of manganese in humans by other routes of exposure was unavailable.



### **3.3.4.2 Animals**

Swiss mice were given doses of manganese (II) chloride tetrahydrate by subcutaneous injection at doses of 0, 2, 4, 8, or 16 mg/kg/day on gestation days 6-15. Maternal body weight gain and feed consumption were significantly reduced in the 8 and 16 mg/kg groups as compared to controls. There was an increase in the number of late resorptions in the 4, 8, and 16 mg/kg groups; and a reduction in fetal body weights and an increase in delayed ossification of the bones of the skull and sternebra in fetuses from the 8 and 16 mg/kg groups (Sánchez, et al., 1993).

## **3.4. TARGET ORGANS/CRITICAL EFFECTS**

### **3.4.1. Oral Exposures**

#### **3.4.1.1. Primary Target(s)**

1. Central nervous system: Initial symptoms include headache, insomnia, disorientation, speech disturbances, memory loss, and acute anxiety. Prompt removal of the affected person from the manganese source usually results in reversal of most of these symptoms. Continued subchronic to chronic exposure can result in motor difficulties, tremors, difficulty walking, and exaggerated reflexes similar to Parkinson's disease. These later stages of toxicity are apparently secondary effects and are not reversible even though the manganese concentrations in the tissues decrease to normal levels upon removal from the manganese source.

2. Reproductive system: Chronic feeding studies in rats have indicated decreased fertility results from chronic manganese exposure. Similar subchronic studies in monkeys have shown degenerative changes in the seminiferous tubules.

#### **3.4.1.2. Other Targets**

Blood: An iron-responsive anemia can occur with orally-induced manganese toxicity possibly due to an interference with intestinal iron absorption by excess manganese.

### **3.4.2. Inhalation Exposures**

#### **3.4.2.1. Primary Target(s)**

1. Central nervous system: The same symptoms are seen as with acute to chronic oral exposure (Sect. 3.4.1.1.). Since individuals are occupationally exposed to dust containing manganese during mining and manufacturing and to metal fumes during welding, inhalation is by far the most common route of exposure for manganese toxicity.

2. Respiratory system: Subchronic to chronic symptoms include an increased incidence of colds, bronchitis and pneumonia. Dyspnea during exercise, decreased vital capacity and decreased forced expiratory vital capacity have also been reported.

3. Reproductive system: Decreased fertility has been seen in subchronic to chronic human inhalation studies.

#### **3.4.2.2. Other Targets**

1. Pancreas: Manganese is known to concentrate in the pancreas and to alter insulin production in rats. Acute pancreatitis has been reported in humans following accidental intravenous exposure.

2. Immune system: There is evidence in animal studies that acute manganese exposure by inhalation results in an immunosuppression. The observed increase in the incidence of

respiratory infections with subchronic to chronic human exposure to manganese substantiates this observation.

#### **4. CARCINOGENICITY**

##### **4.1. ORAL EXPOSURES**

Information on the carcinogenicity of manganese by the oral route in humans or animals was unavailable.

##### **4.2. INHALATION EXPOSURES**

Information on the carcinogenicity of manganese by the inhalation route in humans or animals was unavailable.

##### **4.3. OTHER ROUTES OF EXPOSURE**

###### **4.3.1. Human**

Information on the carcinogenicity of manganese by other routes of exposure in humans was unavailable.

###### **4.3.2. Animal**

DBA/1 mice were injected subcutaneously or intraperitoneally with 0.1 mL of a 1% aqueous solution of manganese chloride twice weekly for 6 months. An increased number of lymphosarcomas developed in the treated animals compared with the controls. The tumor incidence/number of animals in the dose group was: 24/36, 16/39 and 16/66 for the subcutaneous, intraperitoneal and water control groups, respectively. The tumors appeared earlier in the treated groups as well (DiPaolo, 1964).

Groups of 10 male and 10 female each of strain A Strong mice were injected intraperitoneally with 0, 6, 15 or 30 mg/kg manganous sulfate 3 times/week for 7 weeks. The animals were sacrificed and examined for tumors after 30 weeks. There was an apparent increase in the average number of pulmonary adenomas/mouse at the mid and high doses but the increase was significant only at the high dose (Stoner et al., 1976).

F344 rats and female Swiss mice were injected intramuscularly with manganese powder and manganese dioxide (10 mg each). The F344 rats were also injected with manganese<sup>2+</sup> acetylacetonate. No differences were seen in tumor incidence between treated and control animals with manganese powder or manganese dioxide; however, there was a significant increase in injection site fibrosarcomas with the manganese<sup>2+</sup> acetylacetonate (Furst, 1978).

Witschi et al. (1981) injected female A/J mice intraperitoneally with 80 mg/kg methylcyclopentadienyl manganese tricarbonyl. Cell proliferation was produced in the lungs but no increase in tumor incidence was seen.

##### **4.4. EPA WEIGHT-OF-EVIDENCE**

Classification D — Not classifiable as to human carcinogenicity (U.S. EPA, 1995)

Basis — Existing studies are inadequate to assess the carcinogenicity of manganese.

##### **4.5. CARCINOGENICITY SLOPE FACTORS**

None were calculated.

## 5. REFERENCES

- Adkins, B., Jr., G.H. Luginbuhl, F.J. Miller and D.E. Gardner. 1980. Increased pulmonary susceptibility to streptococcal infection following inhalation of manganese oxide. *Environ. Res.* 23: 110-120.
- Baly, D.L., B. Lonnerdal and C.L. Keen. 1985. Effects of high doses of manganese on carbohydrate homeostasis. *Toxicology Letters*. 25: 95-102.
- Bird, E.D., A.H. Anton and B. Bullock. 1984. The effect of manganese inhalation on basal ganglia dopamine concentrations in rhesus monkeys. *Neurotoxicology*. 5(1): 59-66.
- Brock, A.A., S.A. Chapman, E.A. Ulman and G. Wu. 1994. Dietary manganese deficiency decreases rat hepatic arginase activity. *J. Nutr.* 124:340-344.
- Chandra, S.V., G.S. Shukla, R.S. Strivastava, H. Singh and V.P. Gupta. 1981. An exploratory study of manganese exposure to welders. *Clin. Toxicol.* 18: 407-416.
- Chirase, N.K., D.P. Hutcheson, G.B. Thompson and J.W. Spears. 1994. Recovery rate and plasma zinc and copper concentrations of steer calves fed organic and inorganic zinc and manganese sources with or without injectable copper and challenged with infectious bovine rhinotracheitis virus. *J. Anim. Sci.* 72:212-219.
- DiPaolo, J.A. 1964. The potentiation of lymphosarcomas in mice by manganous chloride. *Fed. Proc.* 23: 393.
- Furst, A. 1978. Tumorigenic effect of an organomanganese compound on F344 rats and Swiss albino mice: Brief communication. *J. Natl. Cancer Inst.* 60: 1171-1173.
- Golub, M.S., B. Han, and C.L. Keen. 1991. Al and Mn: interactions in adult and developing mice. *Teratology* 43:490.
- Gupta, S.K., R.C. Murthy and S.V. Chandra. 1980. Neuromelanin in manganese-exposed primates. *Toxicol. Lett.* 6(1): 17-20.
- Holbrook, C.J. Jr., M.E. Washington, H.B. Leake and P.E. Brubaker. 1975. Studies on the evaluation of the toxicity of various salts of lead, manganese, platinum, and palladium. *Environ. Health Persp.* 10: 95-101.
- Iregren, A. 1990. Psychological test performance in foundry workers exposed to low levels of manganese. *Neurotox. Teratol.* 12: (in press).
- Kawamura, R., H. Ikuta, S. Fukuzumi, et al. 1941. Intoxication by manganese in well water. *Kitasato Arch. Exp. Med.* 18: 145-169.
- Keen, C.L. and R.M. Leach. 1988. Manganese. In: *Handbook on Toxicity of Inorganic Compounds*, eds. H.G. Seiler and H. Sigel, Marcel Dekker, Inc. pp. 405-415.
- Komura, J. and M. Sakamoto. 1992. Effects of manganese forms on biogenic amines in the brain and behavioral alterations in the mouse: long-term oral administration of several manganese compounds. *Environ. Res.* 57:34-44.
- Kondakis, X.G., N. Makris, M. Leotsinidis, M. Prinou and T. Papapetropoulos. 1989. Possible health effects of high manganese concentration in drinking water. *Arch. Environ. Health.* 44(3): 175-178.
- Lai, J.C.K., T.K.C. Leung and L. Lim. 1981. Brain regional distribution of glutamic acid decarboxylase, choline acetyltransferase, and acetylcholinesterase in the rat: Effects of chronic manganese chloride administration after two years. *J. Neurochem.* 36(4): 1443-1448.

Lai, J.C., T.K. Leung, L. Lim, A.W. Chan and M.J. Minski. 1991. Effects of chronic manganese treatment on rat brain regional sodium-potassium-activated and magnesium-activated adenosine triphosphatase activities during development. *Metab. Brain Dis.* 6:165-174.

Laskey, J.W., G.L. Rehnberg, J.F. Hein and S.D. Carter. 1982. Effects of chronic manganese ( $Mn_3O_4$ ) exposure on selected reproductive parameters in rats. *J. Toxicol. Environ. Health.* 9: 677-687.

Lauwerys, R., H. Roels, P. Genet, et al. 1985. Fertility of male workers exposed to mercury vapor or to manganese dust: A questionnaire study. *Am. J. Ind. Med.* 7: 171-176.

Lee, K.C. 1993. Hemodynamic and electrophysiologic effects of manganese independent of calcium in anesthetized rabbits. *Meth. Find. Exp. Clin. Pharmacol.* 15:743-750.

Leung, T.K.C., J.C.K. Lai and L. Lim. 1981. The regional distribution of monoamine oxidase activities towards different substrates: Effects in rat brain of chronic administration of manganese chloride and of aging. *J. Neurochem.* 36(6): 2037-2043.

Leung, T.K.C., L. Lim and J.C.K. Lia. 1993. Brain regional distributions of monoamine oxidase activities in postnatal development in normal and chronically manganese-treated rats. *Metab. Brain Dis.* 8:137-149.

Lewis, R.J. and D.V. Sweet, eds. 1984. Registry of Toxic Effects of Chemical Substances, Vol. 1. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Cincinnati, OH.

Massaro, E.J., R.B. D'Agostino, C. Stineman, J.B. Marganti and B.A. Lown. 1980. Alterations in behavior of adult offspring of female mice exposed to  $MnO_2$  dust during gestation. *Fed. Proc. Fed. Am. Soc. Exp. Biol.* 39: 623.

Mergler, D., G. Huel, R. Bowler, A. Iregren, S. Bélanger, M. Baldwin, R. Tardif, A. Amargiassi and L. Martin. 1994. Nervous system dysfunction among workers with long-term exposure to manganese. *Environ. Res.* 64:151-180.

Murthy, R.C., R.S. Srivastava, S.K. Gupta and S.V. Chandra. 1980. Manganese induced testicular changes in monkeys. *Exp. Path.* 18: 240-244.

NRC (National Research Council). 1989. Recommended Dietary Allowances, 9th rev. ed. Food and Nutrition Board, National Research Council, National Academy Press, Washington, DC. p. 230-235.

Orten, J.M. and O.W. Neuhaus. 1975. Human Biochemistry, Ninth Edition, The C.V. Mosby Company, St. Louis. pp. 546-547.

Proctor, N.H., J.P. Hughes and M.L. Fischman. 1988. Manganese (and Compounds) in: Chemical Hazards of the Workplace, Second Edition, J.B. Lippincott Company, Philadelphia. pp.307-308.

Roels, H., R. Lauwerys, J.P. Buchet, et al. 1987. Epidemiological survey among workers exposed to manganese: Effects on lung, central nervous system, and some biological indices. *Am. J. Ind. Med.* 11: 307-328.

Roels, H., P. Ghyselen, J.P. Buchet, E. Ceulemans, and R.R. Lauwerys. 1992. Assessment of permissible exposure level to manganese in workers exposed to manganese dioxide dust. *Br. J. Ind. Med.* 49:25-34.

Sánchez, D.J., J.L. Dominge, J.M. Llobet, and C.L. Keen. 1993. Maternal and developmental toxicity of manganese in the mouse. *Toxicol. Lett.* 69:45-52.

Schroeder, H.A., D.D. Balassa and I.H. Tipton. 1966. Essential trace metals in man: Manganese, a study in homeostasis. *J. Chron. Dis.* 19: 545-571.

Shiotsuka, R.N. 1984. Inhalation toxicity of manganese dioxide and magnesium oxide-manganese dioxide mixture. *GRAI.* 85(7): 34.

Sloot, W.N., A.J. van der Sluijs-Gelling and J.B.P. Gramsbergen. 1994. Selective lesions by manganese and extensive damage by iron after injection into rat striatum or hippocampus. *J. Neurochem.* 62:205-216.

Stokinger, H.E. 1981. The Metals. In *Patty's Industrial Hygiene and Toxicology*, Vol 2A, eds. G.D. Clayton and F.E. Clayton, John Wiley & Sons, New York. pp. 1749-1769.

Stoner, G.D., M.B. Shimkin, M.C. Troxell, T.L. Thompson and L.S. Terry. 1976. Test for carcinogenicity of metallic compounds by the pulmonary tumor response in strain A mice. *Cancer Res.* 36: 1744-1747.

Subhash, M.N. and T.S. Padmashree. 1991. Effect of manganese on biogenic amine metabolism in regions of the rat brain. *Fd. Chem. Toxic.* 29:579-582.

Suzuki, Y., N. Fujii, H. Yano, T. Ohkita, A. Ichikawa and K. Nishiyama. 1978. Effects of the inhalation of manganese dioxide dust on monkey lungs. *Tokushima J. Exp. Med.* 25: 119-125.

Taylor, P.A. and J.D.E. Price. 1982. Acute manganese intoxication and pancreatitis in a patient treated with a contaminated dialysate. *Can. Med. Assoc. J.* 126: 503-505.

Testolin, G., S. Ciappellano, A. Alberio, F. Piccinini, L. Paracchini and A. Jotti. 1993. Intestinal absorption of manganese: an in vitro study. *Ann. Nutr. Metab.* 37:289-294.

U.S. EPA. 1984. Health Assessment Document for Manganese. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Research Triangle Park, NC. EPA 600/8-83-013F.

U.S. EPA. 1989. Reportable Quantity Document for Manganese. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response, Washington, DC.

U.S. EPA. 1994. Health Effects Assessment Summary Tables FY-1994 Annual. Prepared by the Office of Research and Development, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington DC. NTIS PB94-921199.

U.S. EPA. 1995. Integrated Risk Information System (IRIS). Health Risk Assessment for Manganese. On line. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH.

Villalobos, V., F. Castro, E. Bonilla, J. Estévez, and J.O. Dávila. 1994. Manganese toxicity: muscarinic receptor binding in the mouse brain. *J. Toxicol. Environ. Health* 42:185-191.

WHO (World Health Organization). 1973. Trace elements in human nutrition: Manganese. Report of a WHO Expert Committee. Technical Report Service, 532, Who, Geneva, Switzerland. p. 34-36.

Witschi, H.P., P.J. Hakkinen and J.P. Kehrer. 1981. Modification of lung tumor development in A.J mice. *Toxicology.* 21: 37-45.

## **Appendix H**

### **Exposure and Risk Estimates**

FT SHERIDAN HRAV AND JRAV ARES -- CURRENT RECREATIONAL  
Carcinogenic Intakes and Risks

11:55 Wednesday, March 11, 1998 8

TAREA	RECEPTOR	SCENARIO	MEDIUM	PATHWAY	CHEMNAME	INTAKE	ORALWOE	INHWOE	RMERISK
=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
RAV	LIFREC	CREC	SE	DERM	DDD, p,p'-	2.35E-06	B2	B2	8.06E-07
				ORAL	Benzo(a)pyrene	4.71E-08	B2	B2	3.44E-07
				DERM	Benzo(a)pyrene	4.71E-08	B2	B2	3.44E-07
				DERM	Chlordane, total	1.80E-07	B2	B2	7.86E-08
				ORAL	Benzo(a)anthracene	5.89E-08	B2	B2	4.30E-08
				DERM	Benzo(a)anthracene	5.89E-08	B2	B2	4.30E-08
				ORAL	Benzo(b)fluoranthene	4.71E-08	B2	B2	3.44E-08
				DERM	Benzo(b)fluoranthene	4.71E-08	B2	B2	3.44E-08
				ORAL	Indeno(1,2,3-cd)pyrene	2.36E-08	B2	B2	1.72E-08
				DERM	Indeno(1,2,3-cd)pyrene	2.36E-08	B2	B2	1.72E-08
				ORAL	DDD, p,p'-	5.89E-08	B2	B2	1.41E-08
				ORAL	Dibenz(ah)anthracene	1.59E-09	B2	B2	1.16E-08
				DERM	Dibenz(ah)anthracene	1.59E-09	B2	B2	1.16E-08
				ORAL	Benzo(k)fluoranthene	2.95E-08	B2	B2	2.15E-09
				DERM	Benzo(k)fluoranthene	2.95E-08	B2	B2	2.15E-09
				ORAL	Chlordane, total	4.50E-09	B2	B2	1.58E-09
				ORAL	Chrysene	5.89E-08	B2	B2	4.30E-10
				DERM	Chrysene	5.89E-08	B2	B2	4.30E-10
RAV	LIFREC	CREC	SW	DERM	Bis(2-ethylhexyl) phthalate	8.68E-07	B2	B2	6.08E-08
				DERM	Chloromethane	6.97E-09	C	C	1.13E-10
				ORAL	Chloromethane	2.08E-09	C	C	2.70E-11
				ORAL	Benzo(a)pyrene	2.70E-12	B2	B2	1.97E-11
				DERM	Benzo(a)pyrene	2.70E-12	B2	B2	1.97E-11
				ORAL	Bis(2-ethylhexyl) phthalate	9.07E-10	B2	B2	1.27E-11
				ORAL	Benzo(k)fluoranthene	2.13E-12	B2	B2	1.56E-13
				DERM	Benzo(k)fluoranthene	2.13E-12	B2	B2	1.56E-13
RAV	LIFREC	CREC	SE	DERM	DDT, p,p'-	1.39E-06	B2	B2	6.74E-07
				DERM	Chlordane, total	1.22E-06	B2	B2	5.35E-07
				DERM	DDD, p,p'-	1.55E-06	B2	B2	5.32E-07
				ORAL	DDT, p,p'-	3.48E-08	B2	B2	1.18E-08
				ORAL	Chlordane, total	3.06E-08	B2	B2	1.07E-08
				ORAL	DDD, p,p'-	3.89E-08	B2	B2	9.33E-09
				ORAL	Benzo(a)pyrene	1.01E-09	B2	B2	7.41E-09
				DERM	Benzo(a)pyrene	1.01E-09	B2	B2	7.41E-09
				ORAL	Dibenz(ah)anthracene	5.04E-10	B2	B2	3.68E-09
				DERM	Dibenz(ah)anthracene	5.04E-10	B2	B2	3.68E-09
				ORAL	Benzo(b)fluoranthene	1.14E-09	B2	B2	8.29E-10
				DERM	Benzo(b)fluoranthene	1.14E-09	B2	B2	8.29E-10
				ORAL	Indeno(1,2,3-cd)pyrene	7.94E-10	B2	B2	5.79E-10
				DERM	Indeno(1,2,3-cd)pyrene	7.94E-10	B2	B2	5.79E-10
				ORAL	Benzo(a)anthracene	7.26E-10	B2	B2	5.30E-10
				DERM	Benzo(a)anthracene	7.26E-10	B2	B2	5.30E-10
				ORAL	Benzo(k)fluoranthene	7.91E-10	B2	B2	5.78E-11
				DERM	Benzo(k)fluoranthene	7.91E-10	B2	B2	5.78E-11
				ORAL	Chrysene	8.66E-10	B2	B2	6.32E-12
				DERM	Chrysene	8.66E-10	B2	B2	6.32E-12

FT SHERIDAN HRAV AND JRAV AREAS -- FUTURE RECREATIONAL A  
Carcinogenic Intakes and Risks

11:55 Wednesday, March 11, 1998

CONTAREA =====	RECEPTOR =====	SCENARIO =====	MEDIUM =====	PATHWAY =====	CHEMNAME =====	INTAKE =====	ORALWOE =====	INHWOE =====	RMRISK =====
HRAV	LIFREC	FRCA	SE	ORAL	Benzo(a)pyrene	1.25E-06	B2	B2	9.12E-0
				DERM	Benzo(a)pyrene	1.25E-06	B2	B2	9.12E-0
				DERM	DDD, p,p'-	5.51E-06	B2	B2	1.89E-0
				ORAL	Benzo(a)anthracene	1.56E-06	B2	B2	1.14E-0
				DERM	Benzo(a)anthracene	1.56E-06	B2	B2	1.14E-0
				ORAL	Benzo(b)fluoranthene	1.25E-06	B2	B2	9.12E-0
				DERM	Benzo(b)fluoranthene	1.25E-06	B2	B2	9.12E-0
				ORAL	Indeno(1,2,3-cd)pyrene	6.25E-07	B2	B2	4.56E-0
				DERM	Indeno(1,2,3-cd)pyrene	6.25E-07	B2	B2	4.56E-0
				ORAL	DDD, p,p'-	1.56E-06	B2	B2	3.75E-0
				ORAL	Dibenz(ah)anthracene	4.21E-08	B2	B2	3.08E-0
				DERM	Dibenz(ah)anthracene	4.21E-08	B2	B2	3.08E-0
				DERM	Chlordane, total	4.22E-07	B2	B2	1.84E-0
				ORAL	Benzo(k)fluoranthene	7.81E-07	B2	B2	5.70E-0
				DERM	Benzo(k)fluoranthene	7.81E-07	B2	B2	5.70E-0
				ORAL	Chlordane, total	1.19E-07	B2	B2	4.18E-0
				ORAL	Chrysene	1.56E-06	B2	B2	1.14E-0
				DERM	Chrysene	1.56E-06	B2	B2	1.14E-0
HRAV	LIFREC	FRCA	SW	DERM	Bis(2-ethylhexyl) phthalate	7.68E-06	B2	B2	5.37E-0
				DERM	Chloromethane	6.16E-08	C	C	1.00E-0
				ORAL	Chloromethane	1.49E-08	C	C	1.93E-1
				ORAL	Benzo(a)pyrene	1.93E-11	B2	B2	1.41E-1
				DERM	Benzo(a)pyrene	1.93E-11	B2	B2	1.41E-1
				ORAL	Bis(2-ethylhexyl) phthalate	6.48E-09	B2	B2	9.07E-1
				ORAL	Benzo(k)fluoranthene	1.52E-11	B2	B2	1.11E-1
				DERM	Benzo(k)fluoranthene	1.52E-11	B2	B2	1.11E-1
JRAV	LIFREC	FRCA	SE	DERM	DDT, p,p'-	3.25E-06	B2	B2	1.58E-0
				DERM	Chlordane, total	2.87E-06	B2	B2	1.25E-0
				DERM	DDD, p,p'-	3.64E-06	B2	B2	1.25E-0
				ORAL	DDT, p,p'-	9.21E-07	B2	B2	3.13E-0
				ORAL	Chlordane, total	8.12E-07	B2	B2	2.84E-0
				ORAL	DDD, p,p'-	1.03E-06	B2	B2	2.47E-0
				ORAL	Benzo(a)pyrene	2.69E-08	B2	B2	1.96E-0
				DERM	Benzo(a)pyrene	2.69E-08	B2	B2	1.96E-0
				ORAL	Dibenz(ah)anthracene	1.34E-08	B2	B2	9.75E-0
				DERM	Dibenz(ah)anthracene	1.34E-08	B2	B2	9.75E-0
				ORAL	Benzo(b)fluoranthene	3.01E-08	B2	B2	2.20E-0
				DERM	Benzo(b)fluoranthene	3.01E-08	B2	B2	2.20E-0
				ORAL	Indeno(1,2,3-cd)pyrene	2.10E-08	B2	B2	1.54E-0
				DERM	Indeno(1,2,3-cd)pyrene	2.10E-08	B2	B2	1.54E-0
				ORAL	Benzo(a)anthracene	1.93E-08	B2	B2	1.41E-0
				DERM	Benzo(a)anthracene	1.93E-08	B2	B2	1.41E-0
				ORAL	Benzo(k)fluoranthene	2.10E-08	B2	B2	1.53E-0
				DERM	Benzo(k)fluoranthene	2.10E-08	B2	B2	1.53E-0
				ORAL	Chrysene	2.30E-08	B2	B2	1.68E-1
				DERM	Chrysene	2.30E-08	B2	B2	1.68E-1



FT SHERIDAN BEACH ARES -- FUTURE RECREATIONAL B  
Carcinogenic Intakes and Risks

11:55 Wednesday, March 11, 1998 10

ONTAREA =====	RECEPTOR =====	SCENARIO =====	MEDIUM =====	PATHWAY =====	CHEMNAME =====	INTAKE =====	ORALWOE =====	INHWOE =====	RMERISK =====
Beach	LIFREC	FRCB	SE	ORAL	Arsenic	2.14E-06	A	A	3.21E-06
				DERM	Arsenic	5.67E-07	A	A	8.95E-07
				ORAL	Beryllium	7.84E-08	B2	B2	3.37E-07
				DERM	Beryllium	6.92E-09	B2	B2	1.49E-07
Beach	LIFREC	FRCB	SW	DERM	Chloroform	6.77E-08	B2	B2	4.13E-10
				ORAL	Chloroform	7.70E-09	B2	B2	4.70E-11

FT SHERIDAN HRAV AND JRAV ARES -- CURRENT RECREATIONAL  
Noncarcinogenic Intakes and Hazard Indices

11:55 Wednesday, March 11, 1998

CONTAREA =====	RECEPTOR =====	SCENARIO =====	MEDIUM =====	PATHWAY =====	CHEMNAME =====	INTAKE =====	ORALWOE =====	INHWOE =====	RMEHI =====
HRAV	ADREC	CREC	SE	DERM	DDD, p,p'-	5.48E-06	B2	B2	1.57E-0
				DERM	Chlordane, total	4.19E-07	B2	B2	1.05E-0
				ORAL	DDD, p,p'-	1.37E-07	B2	B2	2.74E-0
				ORAL	Chlordane, total	1.05E-08	B2	B2	2.10E-0
				ORAL	Benz(a)anthracene	1.37E-07	B2	B2	4.57E-0
				ORAL	Chrysene	1.37E-07	B2	B2	4.57E-0
				DERM	Benz(a)anthracene	1.37E-07	B2	B2	4.57E-0
				DERM	Chrysene	1.37E-07	B2	B2	4.57E-0
				ORAL	Benzo(a)pyrene	1.10E-07	B2	B2	3.65E-0
				ORAL	Benzo(b)fluoranthene	1.10E-07	B2	B2	3.65E-0
				DERM	Benzo(a)pyrene	1.10E-07	B2	B2	3.65E-0
				DERM	Benzo(b)fluoranthene	1.10E-07	B2	B2	3.65E-0
				ORAL	Benzo(k)fluoranthene	6.85E-08	B2	B2	2.28E-0
				DERM	Benzo(k)fluoranthene	6.85E-08	B2	B2	2.28E-0
				ORAL	Indeno(1,2,3-cd)pyrene	5.48E-08	B2	B2	1.83E-0
				DERM	Indeno(1,2,3-cd)pyrene	5.48E-08	B2	B2	1.83E-0
				ORAL	Dibenz(ah)anthracene	3.70E-09	B2	B2	1.23E-0
				DERM	Dibenz(ah)anthracene	3.70E-09	B2	B2	1.23E-0
HRAV	ADREC	CREC	SW	DERM	Bis(2-ethylhexyl) phthalate	2.54E-06	B2	B2	6.35E-0
				DERM	Manganese	5.07E-07			3.59E-0
				ORAL	Manganese	5.07E-07			1.08E-0
				ORAL	Sulfate	8.79E-05			7.71E-0
				DERM	Chloromethane	2.04E-08	C	C	7.08E-0
				ORAL	Chloromethane	4.85E-09	C	C	1.35E-0
				ORAL	Bis(2-ethylhexyl) phthalate	2.12E-09	B2	B2	1.06E-0
				ORAL	Benzo(a)pyrene	6.30E-12	B2	B2	2.10E-1
				DERM	Benzo(a)pyrene	6.30E-12	B2	B2	2.10E-1
				ORAL	Benzo(k)fluoranthene	4.97E-12	B2	B2	1.66E-1
				DERM	Benzo(k)fluoranthene	4.97E-12	B2	B2	1.66E-1
				DERM	Sulfate	8.79E-05			
JRAV	ADREC	CREC	SE	DERM	DDD, p,p'-	3.62E-06	B2	B2	1.03E-0
				DERM	DDT, p,p'-	3.23E-06	B2	B2	9.24E-0
				DERM	Chlordane, total	2.85E-06	B2	B2	7.12E-0
				ORAL	DDD, p,p'-	9.04E-08	B2	B2	1.81E-0
				ORAL	DDT, p,p'-	8.08E-08	B2	B2	1.62E-0
				ORAL	Chlordane, total	7.12E-08	B2	B2	1.42E-0
				ORAL	Benzo(b)fluoranthene	2.64E-09	B2	B2	8.80E-0
				DERM	Benzo(b)fluoranthene	2.64E-09	B2	B2	8.80E-0
				ORAL	Benzo(a)pyrene	2.36E-09	B2	B2	7.86E-0
				DERM	Benzo(a)pyrene	2.36E-09	B2	B2	7.86E-0
				ORAL	Chrysene	2.01E-09	B2	B2	6.71E-0
				DERM	Chrysene	2.01E-09	B2	B2	6.71E-0
				ORAL	Indeno(1,2,3-cd)pyrene	1.85E-09	B2	B2	6.15E-0
				DERM	Indeno(1,2,3-cd)pyrene	1.85E-09	B2	B2	6.15E-0
				ORAL	Benzo(k)fluoranthene	1.84E-09	B2	B2	6.14E-0
				DERM	Benzo(k)fluoranthene	1.84E-09	B2	B2	6.14E-0
				ORAL	Benz(a)anthracene	1.69E-09	B2	B2	5.63E-0
				DERM	Benz(a)anthracene	1.69E-09	B2	B2	5.63E-0
				ORAL	Dibenz(ah)anthracene	1.17E-09	B2	B2	3.91E-0
				DERM	Dibenz(ah)anthracene	1.17E-09	B2	B2	3.91E-0
JRAV	ADREC	CREC	SW	DERM	Manganese	9.37E-08			6.65E-0
				ORAL	Manganese	9.37E-08			1.99E-0

FT SHERIDAN HRAV AND JRAV ARES -- FUTURE RECREATIONAL A  
Noncarcinogenic Intakes and Hazard Indices

11:55 Wednesday, March 11, 1998 12

AREA	RECEPTOR	SCENARIO	MEDIUM	PATHWAY	CHEMNAME	INTAKE	ORALWOE	INHWOE	RMEHI
=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
RAV	ADREC	FRCA	SE	DERM	DDD, p,p'-	1.10E-05	B2	B2	3.13E-02
				ORAL	DDD, p,p'-	1.37E-06	B2	B2	2.74E-03
				DERM	Chlordane, total	8.38E-07	B2	B2	2.10E-03
				ORAL	Chlordane, total	1.05E-07	B2	B2	2.10E-04
				ORAL	Benzo(a)anthracene	1.37E-06	B2	B2	4.57E-05
				ORAL	Chrysene	1.37E-06	B2	B2	4.57E-05
				DERM	Benzo(a)anthracene	1.37E-06	B2	B2	4.57E-05
				DERM	Chrysene	1.37E-06	B2	B2	4.57E-05
				ORAL	Benzo(a)pyrene	1.10E-06	B2	B2	3.65E-05
				ORAL	Benzo(b)fluoranthene	1.10E-06	B2	B2	3.65E-05
				DERM	Benzo(a)pyrene	1.10E-06	B2	B2	3.65E-05
				DERM	Benzo(b)fluoranthene	1.10E-06	B2	B2	3.65E-05
				ORAL	Benzo(k)fluoranthene	6.85E-07	B2	B2	2.28E-05
				DERM	Benzo(k)fluoranthene	6.85E-07	B2	B2	2.28E-05
				ORAL	Indeno(1,2,3-cd)pyrene	5.48E-07	B2	B2	1.83E-05
				DERM	Indeno(1,2,3-cd)pyrene	5.48E-07	B2	B2	1.83E-05
				ORAL	Dibenz(ah)anthracene	3.70E-08	B2	B2	1.23E-06
				DERM	Dibenz(ah)anthracene	3.70E-08	B2	B2	1.23E-06
RAV	ADREC	FRCA	SW	DERM	Bis(2-ethylhexyl) phthalate	1.53E-05	B2	B2	3.82E-03
				DERM	Manganese	3.05E-06			2.16E-03
				ORAL	Manganese	3.05E-06			6.49E-05
				ORAL	Sulfate	5.30E-04			4.65E-05
				DERM	Chloromethane	1.23E-07	C	C	4.26E-05
				ORAL	Chloromethane	2.92E-08	C	C	8.12E-06
				ORAL	Bis(2-ethylhexyl) phthalate	1.27E-08	B2	B2	6.37E-07
				ORAL	Benzo(a)pyrene	3.79E-11	B2	B2	1.26E-09
				DERM	Benzo(a)pyrene	3.79E-11	B2	B2	1.26E-09
				ORAL	Benzo(k)fluoranthene	3.00E-11	B2	B2	9.99E-10
				DERM	Benzo(k)fluoranthene	3.00E-11	B2	B2	9.99E-10
				DERM	Sulfate	5.30E-04			
RAV	CHREC	FRCA	SE	DERM	DDD, p,p'-	2.05E-05	B2	B2	5.84E-02
				ORAL	DDD, p,p'-	1.28E-05	B2	B2	2.56E-02
				DERM	Chlordane, total	1.56E-06	B2	B2	3.91E-03
				ORAL	Chlordane, total	9.78E-07	B2	B2	1.96E-03
				ORAL	Benzo(a)anthracene	1.28E-05	B2	B2	4.26E-04
				ORAL	Chrysene	1.28E-05	B2	B2	4.26E-04
				DERM	Benzo(a)anthracene	1.28E-05	B2	B2	4.26E-04
				DERM	Chrysene	1.28E-05	B2	B2	4.26E-04
				ORAL	Benzo(a)pyrene	1.02E-05	B2	B2	3.41E-04
				ORAL	Benzo(b)fluoranthene	1.02E-05	B2	B2	3.41E-04
				DERM	Benzo(a)pyrene	1.02E-05	B2	B2	3.41E-04
				DERM	Benzo(b)fluoranthene	1.02E-05	B2	B2	3.41E-04
				ORAL	Benzo(k)fluoranthene	6.39E-06	B2	B2	2.13E-04
				DERM	Benzo(k)fluoranthene	6.39E-06	B2	B2	2.13E-04
				ORAL	Indeno(1,2,3-cd)pyrene	5.11E-06	B2	B2	1.70E-04
				DERM	Indeno(1,2,3-cd)pyrene	5.11E-06	B2	B2	1.70E-04
				ORAL	Dibenz(ah)anthracene	3.45E-07	B2	B2	1.15E-05
				DERM	Dibenz(ah)anthracene	3.45E-07	B2	B2	1.15E-05
RAV	CHREC	FRCA	SW	DERM	Bis(2-ethylhexyl) phthalate	2.85E-05	B2	B2	7.14E-03
				DERM	Manganese	5.70E-06			4.04E-03
				ORAL	Manganese	1.42E-05			3.03E-04
				ORAL	Sulfate	2.47E-03			2.17E-04
				DERM	Chloromethane	2.29E-07	C	C	7.96E-05
				ORAL	Chloromethane	1.36E-07	C	C	3.79E-05
				ORAL	Bis(2-ethylhexyl) phthalate	5.95E-08	B2	B2	2.97E-06
				ORAL	Benzo(a)pyrene	1.77E-10	B2	B2	5.90E-09
				DERM	Benzo(a)pyrene	1.77E-10	B2	B2	5.90E-09
				ORAL	Benzo(k)fluoranthene	1.40E-10	B2	B2	4.66E-09
				DERM	Benzo(k)fluoranthene	1.40E-10	B2	B2	4.66E-09
				DERM	Sulfate	9.89E-04			
RAV	ADREC	FRCA	SE	DERM	DDD, p,p'-	7.23E-06	B2	B2	2.07E-02
				DERM	DDT, p,p'-	6.47E-06	B2	B2	1.85E-02
				DERM	Chlordane, total	5.70E-06	B2	B2	1.42E-02
				ORAL	DDD, p,p'-	9.04E-07	B2	B2	1.81E-03
				ORAL	DDT, p,p'-	8.08E-07	B2	B2	1.62E-03
				ORAL	Chlordane, total	7.12E-07	B2	B2	1.42E-03

FT SHERIDAN HRAV AND JRAV ARES -- FUTURE RECREATIONAL A  
Noncarcinogenic Intakes and Hazard Indices

11:55 Wednesday, March 11, 1998

CONTAREA =====	RECEPTOR =====	SCENARIO =====	MEDIUM =====	PATHWAY =====	CHEMNAME =====	INTAKE =====	ORALWOE =====	INHWOE =====	RMEHI =====
JRAV	ADREC	FRCA	SE	ORAL	Benzo(b)fluoranthene	2.64E-08	B2	B2	8.80E-0
				DERM	Benzo(b)fluoranthene	2.64E-08	B2	B2	8.80E-0
				ORAL	Benzo(a)pyrene	2.36E-08	B2	B2	7.86E-0
				DERM	Benzo(a)pyrene	2.36E-08	B2	B2	7.86E-0
				ORAL	Chrysene	2.01E-08	B2	B2	6.71E-0
				DERM	Chrysene	2.01E-08	B2	B2	6.71E-0
				ORAL	Indeno(1,2,3-cd)pyrene	1.85E-08	B2	B2	6.15E-0
				DERM	Indeno(1,2,3-cd)pyrene	1.85E-08	B2	B2	6.15E-0
				ORAL	Benzo(k)fluoranthene	1.84E-08	B2	B2	6.14E-0
				DERM	Benzo(k)fluoranthene	1.84E-08	B2	B2	6.14E-0
				ORAL	Benzo(a)anthracene	1.69E-08	B2	B2	5.63E-0
				DERM	Benzo(a)anthracene	1.69E-08	B2	B2	5.63E-0
				ORAL	Dibenz(ah)anthracene	1.17E-08	B2	B2	3.91E-0
				DERM	Dibenz(ah)anthracene	1.17E-08	B2	B2	3.91E-0
JRAV	ADREC	FRCA	SW	DERM	Manganese	5.65E-07			4.00E-0
				ORAL	Manganese	5.65E-07			1.20E-0
JRAV	CHREC	FRCA	SE	DERM	DDD, p,p'-	1.35E-05	B2	B2	3.86E-0
				DERM	DDT, p,p'-	1.21E-05	B2	B2	3.45E-0
				DERM	Chlordane, total	1.06E-05	B2	B2	2.66E-0
				ORAL	DDD, p,p'-	8.44E-06	B2	B2	1.69E-0
				ORAL	DDT, p,p'-	7.54E-06	B2	B2	1.51E-0
				ORAL	Chlordane, total	6.65E-06	B2	B2	1.33E-0
				ORAL	Benzo(b)fluoranthene	2.46E-07	B2	B2	8.21E-0
				DERM	Benzo(b)fluoranthene	2.46E-07	B2	B2	8.21E-0
				ORAL	Benzo(a)pyrene	2.20E-07	B2	B2	7.34E-0
				DERM	Benzo(a)pyrene	2.20E-07	B2	B2	7.34E-0
				ORAL	Chrysene	1.88E-07	B2	B2	6.27E-0
				DERM	Chrysene	1.88E-07	B2	B2	6.27E-0
				ORAL	Indeno(1,2,3-cd)pyrene	1.72E-07	B2	B2	5.74E-0
				DERM	Indeno(1,2,3-cd)pyrene	1.72E-07	B2	B2	5.74E-0
				ORAL	Benzo(k)fluoranthene	1.72E-07	B2	B2	5.73E-0
				DERM	Benzo(k)fluoranthene	1.72E-07	B2	B2	5.73E-0
				ORAL	Benzo(a)anthracene	1.58E-07	B2	B2	5.25E-0
				DERM	Benzo(a)anthracene	1.58E-07	B2	B2	5.25E-0
				ORAL	Dibenz(ah)anthracene	1.09E-07	B2	B2	3.65E-0
				DERM	Dibenz(ah)anthracene	1.09E-07	B2	B2	3.65E-0
JRAV	CHREC	FRCA	SW	DERM	Manganese	1.05E-06			7.47E-0
				ORAL	Manganese	2.63E-06			5.61E-0

FT SHERIDAN BEACH ARES -- FUTURE RECREATIONAL B  
Noncarcinogenic Intakes and Hazard Indices

11:55 Wednesday, March 11, 1998 14

CONTAREA	RECEPTOR	SCENARIO	MEDIUM	PATHWAY	CHEMNAME	INTAKE	ORALWOE	INHWOE	RMEHI
=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
Beach	ADREC	FRCB	SE	DERM	Manganese	2.56E-05			1.82E-02
				ORAL	Arsenic	1.88E-06	A	A	6.26E-03
				DERM	Arsenic	1.13E-06	A	A	3.95E-03
				ORAL	Manganese	1.28E-04			2.73E-03
				ORAL	Beryllium	6.88E-08	B2	B2	1.38E-05
				DERM	Beryllium	1.38E-08	B2	B2	1.38E-05
Beach	ADREC	FRCB	SW	DERM	Manganese	1.89E-06			1.34E-03
				ORAL	Sulfate	1.70E-03			1.49E-04
				ORAL	Manganese	1.89E-06			4.02E-05
				DERM	Chloroform	8.42E-08	B2	B2	8.42E-06
				ORAL	Chloroform	9.46E-09	B2	B2	9.46E-07
				DERM	Sulfate	1.70E-03			
Beach	CHREC	FRCB	SE	ORAL	Arsenic	1.75E-05	A	A	5.84E-02
				DERM	Manganese	4.79E-05			3.39E-02
				ORAL	Manganese	1.20E-03			2.55E-02
				DERM	Arsenic	2.10E-06	A	A	7.38E-03
				ORAL	Beryllium	6.42E-07	B2	B2	1.28E-04
				DERM	Beryllium	2.57E-08	B2	B2	2.57E-05
Beach	CHREC	FRCB	SW	DERM	Manganese	1.41E-05			1.00E-02
				ORAL	Sulfate	3.18E-02			2.79E-03
				ORAL	Manganese	3.53E-05			7.50E-04
				DERM	Chloroform	6.29E-07	B2	B2	6.29E-05
				ORAL	Chloroform	1.77E-07	B2	B2	1.77E-05
				DERM	Sulfate	1.27E-02			



Medium	Study Area	Analyte	Upper 95% Conf Limit	Assumed Distribn	Total Number	# of Detects	Coefficient of Variation	Normal S-W p-value	Lognormal S-W p-value	Maximum Detected Concentrn	Exposure Concentrn	Delete Nondetect > Max Hit
Groundwater	Beach	Amino-2,6-dinitrotoluene, 4-	6.27E-05	CV Norml	27	1	4.47E-01	1.89E-13	1.89E-13	1.77E-04	6.27E-05	
		Barium	3.85E-01	Lognorml	34	30	1.30E+00	5.46E-08	2.41E-01	1.03E+00	3.85E-01	
		Benz(a)anthracene	1.30E-05	CV Norml	32	3	4.26E-01	1.43E-13	1.35E-13	3.03E-05	1.30E-05	Yes
		Benzo(a)pyrene	1.21E-05	None Lgn	32	7	1.26E+00	9.99E-12	1.17E-10	5.42E-05	1.21E-05	Yes
		Benzo(ghi)perylene	5.52E-05	CV Norml	31	1	2.07E-01	2.78E-15	2.78E-15	1.10E-04	5.52E-05	Yes
		Benzo(k)fluoranthene	7.63E-06	CV Norml	32	3	6.75E-01	1.28E-13	1.12E-13	2.13E-05	7.63E-06	Yes
		Cobalt	2.79E-02	CV Norml	34	7	1.20E+00	7.16E-12	1.85E-11	1.08E-01	2.79E-02	
		Copper	7.49E-02	None Lgn	34	23	1.54E+00	2.65E-09	2.41E-03	2.38E-01	7.49E-02	
		DDD, p,p'-	4.53E-06	CV Norml	38	3	1.11E+00	0.00E+00	5.55E-17	2.40E-05	4.53E-06	
		DDT, p,p'-	5.02E-06	CV Norml	38	1	8.58E-01	0.00E+00	0.00E+00	2.50E-05	5.02E-06	
		Endosulfan sulfate	8.44E-06	None Lgn	38	4	1.99E+00	2.50E-15	2.86E-12	8.20E-05	8.44E-06	
		Indeno(1,2,3-cd)pyrene	4.00E-05	CV Norml	32	4	7.36E-01	4.05E-13	1.02E-12	1.39E-04	4.00E-05	Yes
		Lead	4.38E-02	None Lgn	34	29	1.32E+00	1.55E-07	4.14E-02	9.50E-02	4.38E-02	
		Manganese	2.14E+00	Lognorml	34	34	1.40E+00	2.02E-08	2.16E-01	4.05E+00	2.14E+00	
		Mercury	1.37E-04	CV Norml	34	3	5.29E-01	1.29E-14	1.13E-14	3.62E-04	1.37E-04	
		Methylnaphthalene, 2-	1.27E-03	CV Norml	39	2	4.87E-01	0.00E+00	0.00E+00	3.80E-03	1.27E-03	
		Pyrene	6.29E-05	CV Norml	32	3	3.73E-01	1.36E-13	1.24E-13	1.33E-04	6.29E-05	Yes
		Vanadium	6.15E-02	None Lgn	34	18	1.74E+00	9.35E-11	1.69E-05	3.36E-01	6.15E-02	
		Zinc	1.54E-01	None Lgn	34	23	1.25E+00	2.11E-07	2.06E-03	4.54E-01	1.54E-01	
Sediment	Beach	Aluminum	3.10E+03	CV Norml	9	4	9.78E-01	4.49E-03	3.04E-01	6.40E+03	3.10E+03	
		Antimony	8.68E+00	None Lgn	9	2	1.22E+00	4.86E-05	6.64E-04	1.78E+01	8.68E+00	
		Arsenic	7.63E+00	CV Norml	9	9	5.07E-01	3.35E-03	1.38E-01	1.31E+01	7.63E+00	
		Chlordane, total	4.05E-01	CV Norml	2	1	1.19E+00	1.00E+00	1.00E+00	1.18E-01	1.18E-01	
		DDD, p,p'-	2.53E-01	CV Norml	7	2	8.05E-01	3.77E-03	4.27E-03	4.30E-01	2.53E-01	
		DDE, p,p'-	1.67E+24	Lognorml	2	1	1.30E+00	1.00E+00	1.00E+00	3.50E-02	3.50E-02	Yes
		DDT, p,p'-	2.15E+50	Lognorml	2	1	1.37E+00	1.00E+00	1.00E+00	9.80E-02	9.80E-02	Yes
		Hexachlorocyclohexane, gamma-	4.17E+16	Lognorml	2	1	1.22E+00	1.00E+00	1.00E+00	1.99E-02	1.99E-02	Yes
		Manganese	5.00E+02	CV Norml	9	9	3.47E-01	7.22E-01	8.11E-01	6.27E+02	5.00E+02	
		Nickel	1.30E+01	CV Norml	9	4	8.57E-01	4.45E-06	3.52E-05	2.78E+01	1.30E+01	
		Zinc	6.84E+01	CV Norml	9	6	9.78E-01	2.59E-03	5.97E-02	1.40E+02	6.84E+01	
Sediment	Hutchinson Ravine	2,4,5-T	1.89E-02	CV Norml	5	1	1.05E+00	0.00E+00	0.00E+00	2.72E-02	1.89E-02	
		Acenaphthene	5.82E+00	Lognorml	11	6	1.29E+00	3.24E-03	8.30E-01	2.45E+00	2.45E+00	
		Acenaphthylene	1.39E+00	Lognorml	11	3	1.54E+00	1.15E-04	5.05E-01	1.73E+00	1.39E+00	
		Aldrin	1.63E-02	None Lgn	10	3	1.47E+00	6.86E-05	2.30E-04	2.53E-02	1.63E-02	Yes
		Anthracene	9.51E+01	Lognorml	11	7	1.22E+00	1.82E-02	5.00E-01	7.00E+00	7.00E+00	
		Benz(a)anthracene	1.64E+01	Lognorml	11	8	1.94E+00	2.90E-05	1.00E-01	1.00E+01	1.00E+01	
		Benzo(a)pyrene	8.56E+00	Lognorml	11	8	1.87E+00	3.67E-05	8.41E-02	8.00E+00	8.00E+00	
		Benzo(b)fluoranthene	8.52E+00	None Lgn	11	8	1.85E+00	4.12E-05	3.70E-02	8.00E+00	8.00E+00	
		Benzo(ghi)perylene	2.74E+00	None Lgn	11	5	1.75E+00	4.48E-05	1.72E-02	4.00E+00	2.74E+00	
		Benzo(k)fluoranthene	6.74E+00	Lognorml	11	9	1.77E+00	6.22E-05	5.92E-01	5.00E+00	5.00E+00	
		Cadmium	3.31E-01	CV Norml	10	1	3.25E-01	4.62E-07	4.62E-07	5.37E-01	3.31E-01	Yes
		Carbazole	1.53E+00	None Lgn	10	2	1.65E+00	6.87E-05	4.17E-03	2.00E+00	1.53E+00	
		Chlordane, alpha-	2.43E-02	None Lgn	10	1	2.67E+00	4.83E-07	7.89E-07	8.60E-02	2.43E-02	Yes
		Chlordane, gamma-	2.96E-02	None Lgn	10	2	2.63E+00	6.57E-07	1.38E-05	9.44E-02	2.96E-02	Yes
		Chlordane, total	7.65E-01	None Lgn	10	5	2.32E+00	3.29E-06	1.62E-02	9.30E-01	7.65E-01	
		Chrysene	1.65E+01	Lognorml	11	8	1.60E+00	1.94E-04	7.99E-01	1.00E+01	1.00E+01	
		Cyanide, total	3.32E-01	CV Norml	11	1	9.91E-01	6.30E-06	7.41E-06	7.83E-01	3.32E-01	
		DDD, p,p'-	3.44E+01	Lognorml	11	11	2.15E+00	6.26E-06	9.98E-01	1.00E+01	1.00E+01	
		DDE, p,p'-	2.92E-01	CV Norml	11	10	1.16E+00	7.97E-03	6.07E-01	5.90E-01	2.92E-01	
		DDT, p,p'-	5.00E-01	CV Norml	11	10	1.06E+00	4.78E-02	4.07E-01	9.30E-01	5.00E-01	

Ecological Exposure Concentrations  
Fort Sheridan Surplus Operable Unit Baseline Risk Assessment

Medium	Study Area	Analyte	Upper 95% Conf Limit		Assumed Distribn	Total Number	# of Detects	Coefficient of Variation	Normal S-W p-value	Lognormal S-W p-value	Maximum Detected Concentrn	Exposure Concentrn	Delete Nondetect > Max Hit
Sediment	Hutchinson Ravine	Dibenz(a,h)anthracene	2.70E-01	CV Norml	11	2	1.08E+00	8.86E-03	9.90E-01	9.90E-01	6.00E-01	2.70E-01	
		Endrin	1.09E-02	None Lgn	10	2	1.46E+00	1.98E-05	1.92E-05	1.92E-05	2.03E-02	1.09E-02	Yes
		Fluoranthene	5.12E+01	Lognorml	11	9	2.11E+00	1.10E-05	4.21E-01	4.21E-01	3.00E+01	3.00E+01	
		Fluorene	3.49E+00	Lognorml	11	6	2.18E+00	3.70E-06	1.31E-01	1.31E-01	4.00E+00	3.49E+00	
		Hexachlorocyclohexane, gamma-	3.38E-03	CV Norml	10	2	7.67E-01	2.01E-05	1.67E-05	1.67E-05	6.28E-03	3.38E-03	Yes
		Indeno(1,2,3-cd)pyrene	4.21E+00	Lognorml	11	6	1.86E+00	2.43E-05	2.05E-01	2.05E-01	4.00E+00	4.00E+00	
		Mercury	9.71E-02	CV Norml	11	2	7.87E-01	1.96E-05	7.87E-04	7.87E-04	2.20E-01	9.71E-02	
		Methylnaphthalene, 2-	7.69E+00	None Lgn	11	5	1.47E+00	1.98E-04	2.02E-02	2.02E-02	3.70E+00	3.70E+00	
		Naphthalene	4.70E+00	Lognorml	11	3	1.46E+00	3.93E-04	3.08E-01	3.08E-01	2.31E+00	2.31E+00	
		Phenanthrene	4.37E+01	Lognorml	11	10	2.12E+00	9.45E-06	4.37E-01	4.37E-01	3.00E+01	3.00E+01	
Sediment	Janes Ravine	Pyrene	4.97E+01	Lognorml	11	9	1.77E+00	9.94E-05	4.41E-01	4.41E-01	2.00E+01	2.00E+01	
		Silver	6.14E-01	CV Norml	11	1	8.87E-01	6.74E-06	5.70E-06	5.70E-06	1.05E+00	6.14E-01	
		Chlordane, total	5.62E+03	Lognorml	6	4	2.36E+00	0.00E+00	5.64E-02	5.64E-02	5.20E+00	5.20E+00	
		DDT, p,p'-	1.62E+04	Lognorml	6	5	2.22E+00	0.00E+00	5.26E-01	5.26E-01	6.60E+00	6.60E+00	
		DDE, p,p'-	1.21E+01	Lognorml	6	5	1.61E+00	9.27E-04	9.66E-01	9.66E-01	4.80E-01	4.80E-01	
		DDT, p,p'-	1.43E+04	Lognorml	6	5	2.28E+00	0.00E+00	5.45E-01	5.45E-01	5.90E+00	5.90E+00	
		Hexachlorocyclohexane, gamma-	4.54E-01	None Lgn	6	2	1.94E+00	6.74E-14	3.29E-02	3.29E-02	7.10E-02	7.10E-02	
		Methoxychlor	1.23E+01	None Lgn	6	1	1.71E+00	1.14E-03	4.45E-03	4.45E-03	1.06E-01	1.06E-01	
		Methylnaphthalene, 2-	2.17E-01	CV Norml	6	1	1.13E+00	3.98E-06	5.45E-02	5.45E-02	3.70E-01	2.17E-01	Yes
		Silver	5.69E-01	CV Norml	4	1	5.51E-01	0.00E+00	0.00E+00	0.00E+00	6.30E-01	5.69E-01	
Sediment	Lake Michigan	Aluminum	1.50E+03	CV Norml	2	2	9.82E-03	1.00E+00	1.00E+00	1.00E+00	1.45E+03	1.45E+03	
		Dinitrobenzene, 1,3-	7.54E-01	CV Norml	2	1	5.76E-01	1.00E+00	1.00E+00	1.00E+00	2.97E-01	2.97E-01	
Surface Water	Beach	Barium	4.43E-02	CV Norml	4	4	2.15E-01	2.44E-01	1.35E-01	1.35E-01	4.20E-02	4.20E-02	
		Manganese Sulfate	2.76E-01	CV Norml	4	4	5.49E-01	9.45E-01	9.04E-01	9.04E-01	2.83E-01	2.76E-01	
Surface Water	Hutchinson Ravine	Sulfate	2.48E+02	CV Norml	4	4	4.97E-01	2.57E-01	6.24E-01	6.24E-01	2.69E+02	2.48E+02	
		Anthracene	8.91E-04	CV Norml	14	3	6.23E-01	1.25E-04	2.54E-04	2.54E-04	9.47E-04	8.91E-04	
		Benzo(a)pyrene	1.11E-05	CV Norml	5	1	6.23E-01	0.00E+00	0.00E+00	0.00E+00	1.47E-05	1.11E-05	Yes
		Cyanide, total	2.20E-03	CV Norml	12	1	7.41E-01	1.01E-07	1.01E-07	1.01E-07	5.33E-03	2.20E-03	
		DDT, p,p'-	6.35E-05	CV Norml	11	6	1.05E+00	2.30E-02	3.85E-03	3.85E-03	1.10E-04	6.35E-05	Yes
		DDE, p,p'-	5.67E-06	CV Norml	11	1	6.00E-01	2.07E-07	2.07E-07	2.07E-07	1.20E-05	5.67E-06	Yes
		DDT, p,p'-	1.00E-05	CV Norml	11	4	8.06E-01	6.44E-04	1.05E-03	1.05E-03	2.00E-05	1.00E-05	Yes
		Decachlorobiphenyl	3.63E-04	CV Norml	3	3	2.21E-01	4.95E-01	5.85E-01	5.85E-01	3.30E-04	3.30E-04	
		Manganese	8.91E-01	CV Norml	12	12	1.17E+00	1.71E-03	4.22E-01	4.22E-01	1.81E+00	8.91E-01	
		Pyrene	1.94E-04	CV Norml	5	1	1.07E+00	0.00E+00	0.00E+00	0.00E+00	2.80E-04	1.94E-04	Yes
Surface Water	Janes Ravine	Sulfate	1.55E+02	CV Norml	9	9	5.43E-01	7.29E-01	6.80E-02	6.80E-02	2.00E+02	1.55E+02	
		DDT, p,p'-	1.55E-05	CV Norml	6	2	7.87E-01	2.91E-01	3.47E-01	3.47E-01	2.20E-05	1.55E-05	
		DDT, p,p'-	1.33E-05	CV Norml	3	1	7.22E-01	0.00E+00	0.00E+00	0.00E+00	1.10E-05	1.10E-05	Yes
		Manganese	2.00E-01	CV Norml	6	6	5.46E-01	7.21E-01	1.17E-02	1.17E-02	2.21E-01	2.00E-01	
		Sulfate	1.61E+02	CV Norml	6	6	3.29E-01	3.88E-01	5.94E-02	5.94E-02	1.70E+02	1.61E+02	

Q:\EAT\_SYS\USERS\COMMON\FTSHERID\OU2REV\MARY\EXPOCONC.LST



Medium	Study Area	Analyte	Upper 95% Conf Limit	Assumed Distribn	Total Number	# of Detects	Coefficient of Variation	Normal S-W p-value	Lognormal S-W p-value	Maximum Detected Concentrn	Exposure Concentrn	Delete Nondetect > Max Hit
Worms	Beach	Aldrin	4.69E-03	CV Norml	2	2	3.44E-01	1.00E+00	1.00E+00	2.30E-03	2.30E-03	
		Aluminum	5.52E+01	CV Norml	2	2	4.09E-01	1.00E+00	1.00E+00	2.52E+01	2.52E+01	
		Amino-4,6-dinitrotoluene, 2-	1.47E+02	CV Norml	2	2	1.29E-01	1.00E+00	1.00E+00	1.02E+02	1.02E+02	
		Arsenic	2.55E-01	CV Norml	2	2	2.81E-03	1.00E+00	1.00E+00	2.52E-01	2.52E-01	
		Barium	2.44E+01	CV Norml	2	2	7.81E-02	1.00E+00	1.00E+00	1.91E+01	1.91E+01	
		Benzyl alcohol	2.93E+00	CV Norml	2	2	6.15E-02	1.00E+00	1.00E+00	2.40E+00	2.40E+00	
		Bis(2-ethylhexyl) phthalate	1.83E+00	CV Norml	2	2	1.18E-01	1.00E+00	1.00E+00	1.30E+00	1.30E+00	
		Cadmium	4.86E-02	CV Norml	2	2	8.13E-02	1.00E+00	1.00E+00	3.77E-02	3.77E-02	
		Calcium	1.50E+03	CV Norml	2	2	3.71E-01	1.00E+00	1.00E+00	7.14E+02	7.14E+02	
		Chlordane, alpha-	6.39E-03	CV Norml	2	2	3.26E-01	1.00E+00	1.00E+00	3.20E-03	3.20E-03	
		Chlordane, gamma-	1.74E-02	CV Norml	2	2	3.30E-01	1.00E+00	1.00E+00	8.69E-03	8.69E-03	
		Chromium, total	1.17E-01	CV Norml	2	2	6.94E-02	1.00E+00	1.00E+00	9.40E-02	9.40E-02	
		Cobalt	2.33E-01	CV Norml	2	2	4.35E-02	1.00E+00	1.00E+00	2.01E-01	2.01E-01	
		Copper	3.84E+00	CV Norml	2	2	3.15E-02	1.00E+00	1.00E+00	3.44E+00	3.44E+00	
		DDT, p,p'-	1.84E-01	CV Norml	2	2	7.67E-01	1.00E+00	1.00E+00	6.40E-02	6.40E-02	
		DDT, p,p'-	1.73E-02	CV Norml	2	2	1.29E-01	1.00E+00	1.00E+00	1.20E-02	1.20E-02	
		DDT, p,p'-	1.12E-02	CV Norml	2	2	1.15E-02	1.00E+00	1.00E+00	3.30E-03	3.30E-03	
		Iron	1.41E+02	CV Norml	2	2	7.87E-02	1.00E+00	1.00E+00	1.10E+02	1.10E+02	
		Lead	3.54E-01	CV Norml	2	2	9.73E-02	1.00E+00	1.00E+00	2.64E-01	2.64E-01	
		Magnesium	2.00E+02	CV Norml	2	2	9.56E-02	1.00E+00	1.00E+00	1.50E+02	1.50E+02	
		Manganese	3.70E+00	CV Norml	2	2	1.07E-01	1.00E+00	1.00E+00	2.69E+00	2.69E+00	
		Nickel	9.00E-01	CV Norml	2	2	2.79E-01	1.00E+00	1.00E+00	4.80E-01	4.80E-01	
		Potassium	1.57E+03	CV Norml	2	2	4.95E-02	1.00E+00	1.00E+00	1.33E+03	1.33E+03	
		RDX	6.12E+00	CV Norml	2	2	2.94E-01	1.00E+00	1.00E+00	3.20E+00	3.20E+00	
		Selenium	4.47E-01	CV Norml	2	2	1.04E-01	1.00E+00	1.00E+00	3.27E-01	3.27E-01	
		Silver	6.46E+02	CV Norml	1	1	1.77E-02	1.00E+00	1.00E+00	4.78E-03	4.78E-03	Yes
		Sodium	1.72E-01	CV Norml	2	2	1.40E-01	1.00E+00	1.00E+00	6.06E+02	6.06E+02	
		Thallium	1.12E-01	CV Norml	2	2	6.89E-02	1.00E+00	1.00E+00	1.16E-01	1.16E-01	
		Vanadium	5.28E+01	CV Norml	2	2	5.49E-03	1.00E+00	1.00E+00	8.95E-02	8.95E-02	
		Zinc			2	2				5.17E+01	5.17E+01	
Worms	Hutchinson Ravine	Aldrin			1	1				1.90E-03	1.90E-03	
		Aluminum			1	1				2.95E+01	2.95E+01	
		Amino-4,6-dinitrotoluene, 2-			1	1				5.25E+01	5.25E+01	
		Arsenic			1	1				3.65E-01	3.65E-01	
		Barium			1	1				1.69E+01	1.69E+01	
		Cadmium			1	1				3.72E-02	3.72E-02	
		Calcium			1	1				3.50E+02	3.50E+02	
		Chlordane, alpha-			1	1				3.60E-03	3.60E-03	
		Chlordane, gamma-			1	1				5.50E-03	5.50E-03	
		Cobalt			1	1				1.70E-01	1.70E-01	
		Copper			1	1				3.25E+00	3.25E+00	
		DDD, p,p'-			1	1				3.80E-01	3.80E-01	
		DDE, p,p'-			1	1				9.60E-02	9.60E-02	
		DDT, p,p'-			1	1				2.30E-03	2.30E-03	
		Iron			1	1				1.14E+02	1.14E+02	
		Lead			1	1				3.27E-01	3.27E-01	
		Magnesium			1	1				1.03E+02	1.03E+02	
		Manganese			1	1				2.41E+00	2.41E+00	
		Mercury			1	1				1.09E-02	1.09E-02	
		Nickel			1	1				3.18E-01	3.18E-01	
		Potassium			1	1				6.15E+02	6.15E+02	

Ecological Exposure Concentrations  
Fort Sheridan Surplus Operable Unit Baseline Risk Assessment

UY:34 Tuesday, March 14, 1990 4

Medium	Study Area	Analyte	Upper 95% Conf Limit	Assumed Distrib	Total Number	# of Detects	Coefficient of Variation	Normal S-W p-value	Lognormal S-W p-value	Maximum Detected Concentr	Exposure Concentr	Delete Nondetect > Max Hit
Worms	Hutchinson Ravine	RDX	.	.	1	1	.	.	.	3.00E+00	3.00E+00	.
		Selenium	.	.	1	1	.	.	.	3.18E-01	3.18E-01	.
		Silver	.	.	1	1	.	.	.	1.17E-02	1.17E-02	.
		Sodium	.	.	1	1	.	.	.	2.12E+02	2.12E+02	.
		Thallium	.	.	1	1	.	.	.	5.13E-02	5.13E-02	.
		Vanadium	.	.	1	1	.	.	.	8.08E-02	8.08E-02	.
Worms	Janes Ravine	Zinc	.	.	1	1	.	.	.	4.83E+01	4.83E+01	.
		Aldrin	.	.	1	1	.	.	.	1.80E-03	1.80E-03	.
		Aluminum	.	.	1	1	.	.	.	7.94E+01	7.94E+01	.
		Amino-4,6-dinitrotoluene, 2-	.	.	1	1	.	.	.	5.50E+01	5.50E+01	.
		Arsenic	.	.	1	1	.	.	.	3.48E-01	3.48E-01	.
		Barium	.	.	1	1	.	.	.	1.56E+01	1.56E+01	.
		Cadmium	.	.	1	1	.	.	.	8.26E-02	8.26E-02	.
		Calcium	.	.	1	1	.	.	.	5.58E+02	5.58E+02	.
		Chlordane, alpha-	.	.	1	1	.	.	.	8.69E-03	8.69E-03	.
		Chlordane, gamma-	.	.	1	1	.	.	.	9.20E-03	9.20E-03	.
		Chromium, total	.	.	1	1	.	.	.	2.17E-01	2.17E-01	.
		Cobalt	.	.	1	1	.	.	.	2.39E-01	2.39E-01	.
		Copper	.	.	1	1	.	.	.	5.27E+00	5.27E+00	.
		DDD, p,p'-	.	.	1	1	.	.	.	8.00E-02	8.00E-02	.
		DDE, p,p'-	.	.	1	1	.	.	.	3.40E-02	3.40E-02	.
		DDT, p,p'-	.	.	1	1	.	.	.	2.40E-03	2.40E-03	.
		Iron	.	.	1	1	.	.	.	1.71E+02	1.71E+02	.
		Lead	.	.	1	1	.	.	.	3.76E-01	3.76E-01	.
		Magnesium	.	.	1	1	.	.	.	1.47E+02	1.47E+02	.
		Manganese	.	.	1	1	.	.	.	4.97E+00	4.97E+00	.
		Mercury	.	.	1	1	.	.	.	1.49E-02	1.49E-02	.
		Nickel	.	.	1	1	.	.	.	1.19E+00	1.19E+00	.
		Potassium	.	.	1	1	.	.	.	6.14E+02	6.14E+02	.
		RDX	.	.	1	1	.	.	.	4.30E+00	4.30E+00	.
		Selenium	.	.	1	1	.	.	.	2.86E-01	2.86E-01	.
		Silver	.	.	1	1	.	.	.	1.03E-02	1.03E-02	.
		Sodium	.	.	1	1	.	.	.	2.30E+02	2.30E+02	.
		Thallium	.	.	1	1	.	.	.	3.76E-02	3.76E-02	.
		Vanadium	.	.	1	1	.	.	.	2.14E-01	2.14E-01	.
		Zinc	.	.	1	1	.	.	.	4.46E+01	4.46E+01	.

Q:\EAT\_SYS\USERS\COMMON\FTSHERID\OU2REV\MARY\WORMECS.LST

## **Appendix I**

### **Risk Tables**

FT SHERIDAN ARES  
CARCINOGENIC RISKS  
CURRENT RECREATIONAL

09:49 Friday, March 13, 1998 1

Zone HRAV; Lifetime Recreation; Chronic

ANALYTE (WOEs: Dermal Oral Inhalation)	MEDIUM						GRAND TOTAL
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Benz(a)anthracene (B2 B2 B2 )	4.3E-08	4.3E-08	8.6E-08				8.6E-08
Benzo(a)pyrene (B2 B2 B2 )	3.4E-07	3.4E-07	6.9E-07	2.0E-11	2.0E-11	3.9E-11	6.9E-07
Benzo(b)fluoranthene (B2 B2 B2 )	3.4E-08	3.4E-08	6.9E-08				6.9E-08
Benzo(k)fluoranthene (B2 B2 B2 )	2.2E-09	2.2E-09	4.3E-09	1.6E-13	1.6E-13	3.1E-13	4.3E-09
Bis(2-ethylhexyl) phthalate (B2 B2 B2 )				6.1E-08	1.3E-11	6.1E-08	6.1E-08
Chlordane, total (B2 B2 B2 )	7.9E-08	1.6E-09	8.0E-08				8.0E-08
Chloromethane (C C C )				1.1E-10	2.7E-11	1.4E-10	1.4E-10
Chrysene (B2 B2 B2 )	4.3E-10	4.3E-10	8.6E-10				8.6E-10
DDD, p,p'- (B2 B2 B2 )	8.1E-07	1.4E-08	8.2E-07				8.2E-07
Dibenz(ah)anthracene (B2 B2 B2 )	1.2E-08	1.2E-08	2.3E-08				2.3E-08
Indeno(1,2,3-cd)pyrene (B2 B2 B2 )	1.7E-08	1.7E-08	3.4E-08				3.4E-08
TOTAL	1.3E-06	4.7E-07	1.8E-06	6.1E-08	6.0E-11	6.1E-08	1.9E-06

Zone JRAV; Lifetime Recreation; Chronic

ANALYTE (WOEs: Dermal Oral Inhalation)				MEDIUM			GRAND TOTAL	
				Sediment				
				PATHWAY		TOTAL		
				Dermal	Oral			
Benz(a)anthracene	(B2	B2	B2	)	5.3E-10	5.3E-10	1.1E-09	1.1E-09
Benzo(a)pyrene	(B2	B2	B2	)	7.4E-09	7.4E-09	1.5E-08	1.5E-08
Benzo(b)fluoranthene	(B2	B2	B2	)	8.3E-10	8.3E-10	1.7E-09	1.7E-09
Benzo(k)fluoranthene	(B2	B2	B2	)	5.8E-11	5.8E-11	1.2E-10	1.2E-10
Chlordane, total	(B2	B2	B2	)	5.3E-07	1.1E-08	5.5E-07	5.5E-07
Chrysene	(B2	B2	B2	)	6.3E-12	6.3E-12	1.3E-11	1.3E-11
DDD, p,p'-	(B2	B2	B2	)	5.3E-07	9.3E-09	5.4E-07	5.4E-07
DDT, p,p'-	(B2	B2	B2	)	6.7E-07	1.2E-08	6.9E-07	6.9E-07
Dibenz(ah)anthracene	(B2	B2	B2	)	3.7E-09	3.7E-09	7.4E-09	7.4E-09
Indeno(1,2,3-cd)pyrene	(B2	B2	B2	)	5.8E-10	5.8E-10	1.2E-09	1.2E-09
TOTAL					1.8E-06	4.5E-08	1.8E-06	1.8E-06

FT SHERIDAN ARES  
CARCINOGENIC RISKS  
FUTURE RECREATIONAL A

09:49 Friday, March 13, 1998 2

Zone HRAV; Lifetime Recreation; Chronic

ANALYTE (WOEs: Dermal Oral Inhalation)	MEDIUM							GRAND TOTAL
	Sediment			Surface Water				
	PATHWAY		TOTAL	PATHWAY		TOTAL		
	Dermal	Oral		Dermal	Oral			
Benz(a)anthracene (B2 B2 B2 )	1.1E-06	1.1E-06	2.3E-06				2.3E-06	
Benzo(a)pyrene (B2 B2 B2 )	9.1E-06	9.1E-06	1.8E-05	1.4E-10	1.4E-10	2.8E-10	1.8E-05	
Benzo(b)fluoranthene (B2 B2 B2 )	9.1E-07	9.1E-07	1.8E-06				1.8E-06	
Benzo(k)fluoranthene (B2 B2 B2 )	5.7E-08	5.7E-08	1.1E-07	1.1E-12	1.1E-12	2.2E-12	1.1E-07	
Bis(2-ethylhexyl) phthalate (B2 B2 B2 )				5.4E-07	9.1E-11	5.4E-07	5.4E-07	
Chlordane, total (B2 B2 B2 )	1.8E-07	4.2E-08	2.3E-07				2.3E-07	
Chloromethane (C C C )				1.0E-09	1.9E-10	1.2E-09	1.2E-09	
Chrysene (B2 B2 B2 )	1.1E-08	1.1E-08	2.3E-08				2.3E-08	
DDD, p,p'- (B2 B2 B2 )	1.9E-06	3.7E-07	2.3E-06				2.3E-06	
Dibenz(ah)anthracene (B2 B2 B2 )	3.1E-07	3.1E-07	6.2E-07				6.2E-07	
Indeno(1,2,3-cd)pyrene (B2 B2 B2 )	4.6E-07	4.6E-07	9.1E-07				9.1E-07	
TOTAL	1.4E-05	1.2E-05	2.6E-05	5.4E-07	4.3E-10	5.4E-07	2.7E-05	

Zone JRAV; Lifetime Recreation; Chronic

ANALYTE (WOEs: Dermal Oral Inhalation)	MEDIUM			GRAND TOTAL
	Sediment			
	PATHWAY		TOTAL	
	Dermal	Oral		
Benz(a)anthracene (B2 B2 B2 )	1.4E-08	1.4E-08	2.8E-08	2.8E-08
Benzo(a)pyrene (B2 B2 B2 )	2.0E-07	2.0E-07	3.9E-07	3.9E-07
Benzo(b)fluoranthene (B2 B2 B2 )	2.2E-08	2.2E-08	4.4E-08	4.4E-08
Benzo(k)fluoranthene (B2 B2 B2 )	1.5E-09	1.5E-09	3.1E-09	3.1E-09
Chlordane, total (B2 B2 B2 )	1.3E-06	2.8E-07	1.5E-06	1.5E-06
Chrysene (B2 B2 B2 )	1.7E-10	1.7E-10	3.4E-10	3.4E-10
DDD, p,p'- (B2 B2 B2 )	1.2E-06	2.5E-07	1.5E-06	1.5E-06
DDT, p,p'- (B2 B2 B2 )	1.6E-06	3.1E-07	1.9E-06	1.9E-06
Dibenz(ah)anthracene (B2 B2 B2 )	9.8E-08	9.8E-08	2.0E-07	2.0E-07
Indeno(1,2,3-cd)pyrene (B2 B2 B2 )	1.5E-08	1.5E-08	3.1E-08	3.1E-08
TOTAL	4.4E-06	1.2E-06	5.6E-06	5.6E-06

FT SHERIDAN ARES  
CARCINOGENIC RISKS  
FUTURE RECREATIONAL B

09:49 Friday, March 13, 1998 3

Zone Beach; Lifetime Recreation; Chronic

ANALYTE (WOEs: Dermal Oral Inhalation)	MEDIUM						GRAND TOTAL
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Arsenic (A A A )	8.9E-07	3.2E-06	4.1E-06				4.1E-06
Beryllium (B2 B2 B2 )	1.5E-07	3.4E-07	4.9E-07				4.9E-07
Chloroform (B2 B2 B2 )				4.1E-10	4.7E-11	4.6E-10	4.6E-10
TOTAL	1.0E-06	3.5E-06	4.6E-06	4.1E-10	4.7E-11	4.6E-10	4.6E-06

FT SHERIDAN ARES  
NONCARCINOGENIC HAZARD INDICES  
CURRENT RECREATIONAL

09:49 Friday, March 13, 1998 4

Zone HRAV; Adult Recreational; Chronic

ANALYTE	MEDIUM						GRAND TOTAL
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Benz(a)anthracene	4.6E-06	4.6E-06	9.1E-06				9.1E-06
Benzo(a)pyrene	3.7E-06	3.7E-06	7.3E-06	2.1E-10	2.1E-10	4.2E-10	7.3E-06
Benzo(b)fluoranthene	3.7E-06	3.7E-06	7.3E-06				7.3E-06
Benzo(k)fluoranthene	2.3E-06	2.3E-06	4.6E-06	1.7E-10	1.7E-10	3.3E-10	4.6E-06
Bis(2-ethylhexyl) phthalate				6.3E-04	1.1E-07	6.3E-04	6.3E-04
Chlordane, total	1.0E-03	2.1E-05	1.1E-03				1.1E-03
Chloromethane				7.1E-06	1.3E-06	8.4E-06	8.4E-06
Chrysene	4.6E-06	4.6E-06	9.1E-06				9.1E-06
DDD, p,p'-	1.6E-02	2.7E-04	1.6E-02				1.6E-02
Dibenz(ah)anthracene	1.2E-07	1.2E-07	2.5E-07				2.5E-07
Indeno(1,2,3-cd)pyrene	1.8E-06	1.8E-06	3.7E-06				3.7E-06
Manganese				3.6E-04	1.1E-05	3.7E-04	3.7E-04
Sulfate					7.7E-06	7.7E-06	7.7E-06
TOTAL	1.7E-02	3.2E-04	1.7E-02	1.0E-03	2.0E-05	1.0E-03	1.8E-02

FT SHERIDAN ARES  
NONCARCINOGENIC HAZARD INDICES  
CURRENT RECREATIONAL

09:49 Friday, March 13, 1998 5

Zone JRAV; Adult Recreational; Chronic

ANALYTE	MEDIUM						GRAND TOTAL
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Benz(a)anthracene	5.6E-08	5.6E-08	1.1E-07				1.1E-07
Benzo(a)pyrene	7.9E-08	7.9E-08	1.6E-07				1.6E-07
Benzo(b)fluoranthene	8.8E-08	8.8E-08	1.8E-07				1.8E-07
Benzo(k)fluoranthene	6.1E-08	6.1E-08	1.2E-07				1.2E-07
Chlordane, total	7.1E-03	1.4E-04	7.3E-03				7.3E-03
Chrysene	6.7E-08	6.7E-08	1.3E-07				1.3E-07
DDD, p,p'-	1.0E-02	1.8E-04	1.1E-02				1.1E-02
DDT, p,p'-	9.2E-03	1.6E-04	9.4E-03				9.4E-03
Dibenz(ah)anthracene	3.9E-08	3.9E-08	7.8E-08				7.8E-08
Indeno(1,2,3-cd)pyrene	6.2E-08	6.2E-08	1.2E-07				1.2E-07
Manganese				6.6E-05	2.0E-06	6.8E-05	6.8E-05
TOTAL	2.7E-02	4.9E-04	2.7E-02	6.6E-05	2.0E-06	6.8E-05	2.7E-02



FT SHERIDAN ARES  
NONCARCINOGENIC HAZARD INDICES  
FUTURE RECREATIONAL A

09:49 Friday, March 13, 1998 6

Zone HRAV; Adult Recreational; Chronic

ANALYTE	MEDIUM						GRAND TOTAL
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Benz(a)anthracene	4.6E-05	4.6E-05	9.1E-05				9.1E-05
Benzo(a)pyrene	3.7E-05	3.7E-05	7.3E-05	1.3E-09	1.3E-09	2.5E-09	7.3E-05
Benzo(b)fluoranthene	3.7E-05	3.7E-05	7.3E-05				7.3E-05
Benzo(k)fluoranthene	2.3E-05	2.3E-05	4.6E-05	1.0E-09	1.0E-09	2.0E-09	4.6E-05
Bis(2-ethylhexyl) phthalate				3.8E-03	6.4E-07	3.8E-03	3.8E-03
Chlordane, total	2.1E-03	2.1E-04	2.3E-03				2.3E-03
Chloromethane				4.3E-05	8.1E-06	5.1E-05	5.1E-05
Chrysene	4.6E-05	4.6E-05	9.1E-05				9.1E-05
DDD, p,p'-	3.1E-02	2.7E-03	3.4E-02				3.4E-02
Dibenz(ah)anthracene	1.2E-06	1.2E-06	2.5E-06				2.5E-06
Indeno(1,2,3-cd)pyrene	1.8E-05	1.8E-05	3.7E-05				3.7E-05
Manganese				2.2E-03	6.5E-05	2.2E-03	2.2E-03
Sulfate					4.6E-05	4.6E-05	4.6E-05
TOTAL	3.4E-02	3.2E-03	3.7E-02	6.0E-03	1.2E-04	6.2E-03	4.3E-02

FT SHERIDAN ARES  
NONCARCINOGENIC HAZARD INDICES  
FUTURE RECREATIONAL A

09:49 Friday, March 13, 1998 7

Zone HRAV; Child Recreational; Chronic

ANALYTE	MEDIUM						GRAND TOTAL
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Benz(a)anthracene	4.3E-04	4.3E-04	8.5E-04				8.5E-04
Benzo(a)pyrene	3.4E-04	3.4E-04	6.8E-04	5.9E-09	5.9E-09	1.2E-08	6.8E-04
Benzo(b)fluoranthene	3.4E-04	3.4E-04	6.8E-04				6.8E-04
Benzo(k)fluoranthene	2.1E-04	2.1E-04	4.3E-04	4.7E-09	4.7E-09	9.3E-09	4.3E-04
Bis(2-ethylhexyl) phthalate				7.1E-03	3.0E-06	7.1E-03	7.1E-03
Chlordane, total	3.9E-03	2.0E-03	5.9E-03				5.9E-03
Chloromethane				8.0E-05	3.8E-05	1.2E-04	1.2E-04
Chrysene	4.3E-04	4.3E-04	8.5E-04				8.5E-04
DDD, p,p'-	5.8E-02	2.6E-02	8.4E-02				8.4E-02
Dibenz(ah)anthracene	1.1E-05	1.1E-05	2.3E-05				2.3E-05
Indeno(1,2,3-cd)pyrene	1.7E-04	1.7E-04	3.4E-04				3.4E-04
Manganese				4.0E-03	3.0E-04	4.3E-03	4.3E-03
Sulfate					2.2E-04	2.2E-04	2.2E-04
TOTAL	6.4E-02	2.9E-02	9.4E-02	1.1E-02	5.6E-04	1.2E-02	1.1E-01

FT SHERIDAN ARES  
NONCARCINOGENIC HAZARD INDICES  
FUTURE RECREATIONAL A

09:49 Friday, March 13, 1998 8

Zone JRAV; Adult Recreational; Chronic

ANALYTE	MEDIUM						GRAND TOTAL
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Benz(a)anthracene	5.6E-07	5.6E-07	1.1E-06				1.1E-06
Benzo(a)pyrene	7.9E-07	7.9E-07	1.6E-06				1.6E-06
Benzo(b)fluoranthene	8.8E-07	8.8E-07	1.8E-06				1.8E-06
Benzo(k)fluoranthene	6.1E-07	6.1E-07	1.2E-06				1.2E-06
Chlordane, total	1.4E-02	1.4E-03	1.6E-02				1.6E-02
Chrysene	6.7E-07	6.7E-07	1.3E-06				1.3E-06
DDD, p,p'-	2.1E-02	1.8E-03	2.2E-02				2.2E-02
DDT, p,p'-	1.8E-02	1.6E-03	2.0E-02				2.0E-02
Dibenz(ah)anthracene	3.9E-07	3.9E-07	7.8E-07				7.8E-07
Indeno(1,2,3-cd)pyrene	6.2E-07	6.2E-07	1.2E-06				1.2E-06
Manganese				4.0E-04	1.2E-05	4.1E-04	4.1E-04
TOTAL	5.3E-02	4.9E-03	5.8E-02	4.0E-04	1.2E-05	4.1E-04	5.9E-02

Zone JRAV; Child Recreational; Chronic

ANALYTE	MEDIUM						GRAND TOTAL
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Benz(a)anthracene	5.3E-06	5.3E-06	1.1E-05				1.1E-05
Benzo(a)pyrene	7.3E-06	7.3E-06	1.5E-05				1.5E-05
Benzo(b)fluoranthene	8.2E-06	8.2E-06	1.6E-05				1.6E-05
Benzo(k)fluoranthene	5.7E-06	5.7E-06	1.1E-05				1.1E-05
Chlordane, total	2.7E-02	1.3E-02	4.0E-02				4.0E-02
Chrysene	6.3E-06	6.3E-06	1.3E-05				1.3E-05
DDD, p,p'-	3.9E-02	1.7E-02	5.5E-02				5.5E-02
DDT, p,p'-	3.4E-02	1.5E-02	5.0E-02				5.0E-02
Dibenz(ah)anthracene	3.6E-06	3.6E-06	7.3E-06				7.3E-06
Indeno(1,2,3-cd)pyrene	5.7E-06	5.7E-06	1.1E-05				1.1E-05
Manganese				7.5E-04	5.6E-05	8.0E-04	8.0E-04
TOTAL	1.0E-01	4.5E-02	1.4E-01	7.5E-04	5.6E-05	8.0E-04	1.5E-01

FT SHERIDAN ARES  
NONCARCINOGENIC HAZARD INDICES  
FUTURE RECREATIONAL B

09:49 Friday, March 13, 1998 9

Zone Beach; Adult Recreational; Chronic

ANALYTE	MEDIUM						GRAND TOTAL
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Arsenic	4.0E-03	6.3E-03	1.0E-02				1.0E-02
Beryllium	1.4E-05	1.4E-05	2.8E-05				2.8E-05
Chloroform				8.4E-06	9.5E-07	9.4E-06	9.4E-06
Manganese	1.8E-02	2.7E-03	2.1E-02	1.3E-03	4.0E-05	1.4E-03	2.2E-02
Sulfate					1.5E-04	1.5E-04	1.5E-04
TOTAL	2.2E-02	9.0E-03	3.1E-02	1.3E-03	1.9E-04	1.5E-03	3.3E-02

Zone Beach; Child Recreational; Chronic

ANALYTE	MEDIUM						GRAND TOTAL
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Arsenic	7.4E-03	5.8E-02	6.6E-02				6.6E-02
Beryllium	2.6E-05	1.3E-04	1.5E-04				1.5E-04
Chloroform				6.3E-05	1.8E-05	8.1E-05	8.1E-05
Manganese	3.4E-02	2.5E-02	5.9E-02	1.0E-02	7.5E-04	1.1E-02	7.0E-02
Sulfate					2.8E-03	2.8E-03	2.8E-03
TOTAL	4.1E-02	8.4E-02	1.3E-01	1.0E-02	3.6E-03	1.4E-02	1.4E-01

FT SHERIDAN  
CARCINOGENIC RISKS  
CURRENT RECREATIONAL

Zone HRAV BACKGROUND; Lifetime Recreation; Chronic

ANALYTE (WOEs: Dermal Oral Inhalation)	MEDIUM						
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY			GRAND TOTAL
	Dermal	Oral		Dermal	Oral	TOTAL	
Benzo(a)anthracene (B2 B2 B2 )	5.7E-09	5.7E-09	1.1E-08				1.1E-08
Benzo(a)pyrene (B2 B2 B2 )	5.6E-08	5.6E-08	1.1E-07				1.1E-07
Benzo(b)fluoranthene (B2 B2 B2 )	5.6E-09	5.6E-09	1.1E-08				1.1E-08
Benzo(k)fluoranthene (B2 B2 B2 )	3.1E-10	3.1E-10	6.1E-10				6.1E-10
Bis(2-ethylhexyl) phthalate (B2 B2 B2 )				3.5E-07	7.4E-11	3.5E-07	3.5E-07
Chlordane, total (B2 B2 B2 )	4.5E-09	9.0E-11	4.5E-09				4.5E-09
Chloromethane (C C C )							
Chrysene (B2 B2 B2 )	5.7E-11	5.7E-11	1.1E-10				1.1E-10
DDD, p,p'-(B2 B2 )	1.7E-08	3.0E-10	1.7E-08				1.7E-08
Dibenz(ah)anthracene (B2 B2 B2 )							
Indeno(1,2,3-cd)pyrene (B2 B2 B2 )	3.0E-09	3.0E-09	6.0E-09				6.0E-09
TOTAL	9.2E-08	7.1E-08	1.6E-07	3.5E-07	7.4E-11	3.5E-07	5.1E-07

FT SHERIDAN  
CARCINOGENIC RISKS  
CURRENT RECREATIONAL

Zone JRAV BACKGROUND; Lifetime Recreation; Chronic

ANALYTE (WOEs: Dermal Oral Inhalation)	MEDIUM				GRAND TOTAL
	Sediment				
	PATHWAY		TOTAL		
	Dermal	Oral			
Benz(a)anthracene	(B2 B2 B2 )	5.7E-09	5.7E-09	1.1E-08	1.1E-08
Benzo(a)pyrene	(B2 B2 B2 )	5.7E-08	5.7E-08	1.1E-07	1.1E-07
Benzo(b)fluoranthene	(B2 B2 B2 )	5.7E-09	5.7E-09	1.1E-08	1.1E-08
Benzo(k)fluoranthene	(B2 B2 B2 )	3.0E-10	3.0E-10	6.0E-10	6.0E-10
Chlordane, total	(B2 B2 B2 )	4.4E-09	9.1E-11	4.6E-09	4.6E-09
Chrysene	(B2 B2 B2 )	5.7E-11	5.7E-11	1.1E-10	1.1E-10
DDD, p,p'-	(B2 B2 )	1.7E-08	3.0E-10	1.7E-08	1.7E-08
DDT, p,p'-	(B2 B2 B2 )	6.6E-09	1.2E-10	6.8E-09	6.8E-09
Dibenzo(a,h)anthracene	(B2 B2 B2 )				
Indeno(1,2,3-cd)pyrene	(B2 B2 B2 )	3.0E-09	3.0E-09	6.1E-09	6.1E-09
TOTAL		1.0E-07	7.2E-08	1.7E-07	1.7E-07

FT SHERIDAN  
CARCINOGENIC RISKS  
FUTURE RECREATIONAL A

Zone HRAV BACKGROUND; Lifetime Recreation; Chronic

ANALYTE (WDEs: Dermal Oral Inhalation)	MEDIUM						
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY			GRAND TOTAL
	Dermal	Oral		Dermal	Oral	TOTAL	
Benzo(a)anthracene	(B2 B2 B2 )	1.5E-07	1.5E-07	3.0E-07			3.0E-07
Benzo(a)pyrene	(B2 B2 B2 )	1.5E-06	1.5E-06	3.0E-06			3.0E-06
Benzo(b)fluoranthene	(B2 B2 B2 )	1.5E-07	1.5E-07	3.0E-07			3.0E-07
Benzo(k)fluoranthene	(B2 B2 B2 )	7.9E-09	7.9E-09	1.6E-08			1.6E-08
Bis(2-ethylhexyl) phthalate	(B2 B2 B2 )				3.1E-06	5.2E-10	3.1E-06
Chlordane, total	(B2 B2 B2 )	1.0E-08	2.4E-09	1.3E-08			1.3E-08
Chloromethane	(C C C )						
Chrysene	(B2 B2 B2 )	1.5E-09	1.5E-09	3.0E-09			3.0E-09
DDD, p,p'-	(B2 B2 B2 )	4.0E-08	7.8E-09	4.9E-08			4.9E-08
Dibenz(ah)anthracene	(B2 B2 B2 )						
Indeno(1,2,3-cd)pyrene	(B2 B2 B2 )	8.2E-08	8.2E-08	1.6E-07			1.6E-07
TOTAL		1.9E-06	1.9E-06	3.8E-06	3.1E-06	5.2E-10	6.9E-06

FT SHERIDAN  
CARCINOGENIC RISKS  
FUTURE RECREATIONAL A

Zone JRAV BACKGROUND; Lifetime Recreation; Chronic

ANALYTE (WQEs: Dermal Oral Inhalation)	MEDIUM				GRAND TOTAL
	Sediment				
	PATHWAY		TOTAL		
	Dermal	Oral			
Benzo(a)anthracene	(B2 B2 B2 )	1.5E-07	1.5E-07	3.0E-07	3.0E-07
Benzo(a)pyrene	(B2 B2 B2 )	1.5E-06	1.5E-06	3.0E-06	3.0E-06
Benzo(b)fluoranthene	(B2 B2 B2 )	1.5E-07	1.5E-07	3.0E-07	3.0E-07
Benzo(k)fluoranthene	(B2 B2 B2 )	7.8E-09	7.8E-09	1.6E-08	1.6E-08
Chlordane, total	(B2 B2 B2 )	1.1E-08	2.3E-09	1.2E-08	1.2E-08
Chrysene	(B2 B2 B2 )	1.5E-09	1.5E-09	3.0E-09	3.0E-09
DDD, p,p'-	(B2 B2 )	3.9E-08	8.0E-09	4.8E-08	4.8E-08
DDT, p,p'-	(B2 B2 B2 )	1.6E-08	3.0E-09	1.9E-08	1.9E-08
Dibenzo(a,h)anthracene	(B2 B2 B2 )				
Indeno(1,2,3-cd)pyrene	(B2 B2 B2 )	7.9E-08	7.9E-08	1.6E-07	1.6E-07
TOTAL		2.0E-06	1.9E-06	3.9E-06	3.9E-06



FT SHERIDAN  
 CARCINOGENIC RISKS  
 FUTURE RECREATIONAL B  
 Zone Beach BACKGROUND; Lifetime Recreation; Chronic

ANALYTE (WQEs: Dermal Oral Inhalation)	MEDIUM						
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY			GRAND TOTAL
	Dermal	Oral		Dermal	Oral	TOTAL	
Arsenic	(A A A )	2.9E-07	1.0E-06	1.3E-06			1.3E-06
Beryllium	(B2 B2 B2 )						
Chloroform	(B2 B2 B2 )						
TOTAL		2.9E-07	1.0E-06	1.3E-06			1.3E-06

FT SHERIDAN  
NONCARCINOGENIC HAZARD INDICES  
CURRENT RECREATIONAL

Zone HRAV BACKGROUND; Adult Recreational; Chronic

ANALYTE	MEDIUM							GRAND TOTAL
	Sediment			Surface Water			TOTAL	
	PATHWAY		TOTAL	PATHWAY		TOTAL		
Dermal	Oral	Dermal		Oral				
Benz(a)anthracene	6.1E-07	6.1E-07	1.2E-06					1.2E-06
Benzo(a)pyrene	6.1E-07	6.1E-07	1.2E-06					1.2E-06
Benzo(b)fluoranthene	6.1E-07	6.1E-07	1.2E-06					1.2E-06
Benzo(k)fluoranthene	3.2E-07	3.2E-07	6.4E-07					6.4E-07
Bis(2-ethylhexyl) phthalate				3.6E-03	6.3E-07	3.6E-03		3.6E-03
Chlordane, total	5.6E-05	1.2E-06	6.2E-05					6.2E-05
Chloromethane								
Chrysene	6.1E-07	6.1E-07	1.2E-06					1.2E-06
DDD, p,p'-	3.4E-04	5.7E-06	3.4E-04					3.4E-04
Dibenz(ah)anthracene								
Indeno(1,2,3-cd)pyrene	3.2E-07	3.2E-07	6.4E-07					6.4E-07
Manganese				6.1E-05	1.9E-06	6.2E-05		6.2E-05
Sulfate								
TOTAL	4.0E-04	1.0E-05	4.1E-04	3.7E-03	2.5E-06	3.7E-03		4.1E-03

FT SHERIDAN  
NONCARCINOGENIC HAZARD INDICES  
CURRENT RECREATIONAL

Zone JRAV BACKGROUND; Adult Recreational; Chronic

ANALYTE	MEDIUM						
	Sediment			Surface Water			GRAND TOTAL
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Benzo(a)anthracene	6.0E-07	6.0E-07	1.2E-06				1.2E-06
Benzo(a)pyrene	6.0E-07	6.0E-07	1.2E-06				1.2E-06
Benzo(b)fluoranthene	6.0E-07	6.0E-07	1.2E-06				1.2E-06
Benzo(k)fluoranthene	3.2E-07	3.2E-07	6.2E-07				6.2E-07
Chlordane, total	5.9E-05	1.2E-06	6.1E-05				6.1E-05
Chrysene	6.0E-07	6.0E-07	1.2E-06				1.2E-06
DDD, p,p'-	3.2E-04	5.8E-06	3.5E-04				3.5E-04
DDT, p,p'-	9.0E-05	1.6E-06	9.2E-05				9.2E-05
Dibenzo(a,h)anthracene							
Indeno(1,2,3-cd)pyrene	3.3E-07	3.3E-07	6.3E-07				6.3E-07
Manganese				6.0E-05	1.8E-06	6.2E-05	6.2E-05
TOTAL	4.7E-04	1.2E-05	5.1E-04	6.0E-05	1.8E-06	6.2E-05	5.7E-04

FT SHERIDAN  
NONCARCINOGENIC HAZARD INDICES  
FUTURE RECREATIONAL A

Zone HRAV BACKGROUND; Adult Recreational; Chronic

ANALYTE	MEDIUM						
	Sediment				Surface Water		
	PATHWAY		TOTAL	PATHWAY		TOTAL	GRAND TOTAL
	Dermal	Oral		Dermal	Oral		
Benz(a)anthracene	6.1E-06	6.1E-06	1.2E-05				
Benzo(a)pyrene	6.1E-06	6.1E-06	1.2E-05				1.2E-05
Benzo(b)fluoranthene	6.1E-06	6.1E-06	1.2E-05				1.2E-05
Benzo(k)fluoranthene	3.2E-06	3.2E-06	6.4E-06				6.4E-06
Bis(2-ethylhexyl) phthalate				2.2E-02	3.6E-06	2.2E-02	2.2E-02
Chlordane, total	1.2E-04	1.2E-05	1.3E-04				1.3E-04
Chloromethane							
Chrysene	6.1E-06	6.1E-06	1.2E-05				1.2E-05
DDD, p,p'-	6.6E-04	5.7E-05	7.2E-04				7.2E-04
Dibenz(ah)anthracene							
Indeno(1,2,3-cd)pyrene	3.2E-06	3.2E-06	6.6E-06				6.6E-06
Manganese				3.7E-04	1.1E-05	3.7E-04	3.7E-04
Sulfate							
TOTAL	8.1E-04	1.0E-04	9.1E-04	2.2E-02	1.5E-05	2.2E-02	2.3E-02

FT SHERIDAN  
NONCARCINOGENIC HAZARD INDICES  
FUTURE RECREATIONAL A

Zone HRAV BACKGROUND; Child Recreational; Chronic

ANALYTE	MEDIUM							
	Sediment				Surface Water			
	PATHWAY		TOTAL		PATHWAY		TOTAL	GRAND TOTAL
	Dermal	Oral			Dermal	Oral		
Benz(a)anthracene	5.7E-05	5.7E-05	1.1E-04					1.1E-04
Benzo(a)pyrene	5.7E-05	5.7E-05	1.1E-04					1.1E-04
Benzo(b)fluoranthene	5.7E-05	5.7E-05	1.1E-04					1.1E-04
Benzo(k)fluoranthene	2.9E-05	2.9E-05	6.0E-05					6.0E-05
Bis(2-ethylhexyl) phthalate					4.0E-02	1.7E-05	4.0E-02	4.0E-02
Chlordane, total	2.2E-04	1.1E-04	3.3E-04					3.3E-04
Chloromethane								
Chrysene	5.7E-05	5.7E-05	1.1E-04					1.1E-04
DDP, p,p'-	1.2E-03	5.5E-04	1.8E-03					1.8E-03
Dibenz(ah)anthracene								
Indeno(1,2,3-cd)pyrene	3.0E-05	3.0E-05	6.0E-05					6.0E-05
Manganese					6.7E-04	5.1E-05	7.2E-04	7.2E-04
Sulfate								
TOTAL	1.7E-03	9.5E-04	2.7E-03		4.1E-02	6.8E-05	4.1E-02	4.3E-02

FT SHERIDAN  
NONCARCINOGENIC HAZARD INDICES  
FUTURE RECREATIONAL A

Zone JRAV BACKGROUND; Adult Recreational; Chronic

ANALYTE	MEDIUM						
	Sediment				Surface Water		
	PATHWAY		TOTAL	PATHWAY		TOTAL	
	Dermal	Oral		Dermal	Oral		
Benzo(a)anthracene	6.1E-06	6.1E-06	1.2E-05				1.2E-05
Benzo(a)pyrene	6.1E-06	6.1E-06	1.2E-05				1.2E-05
Benzo(b)fluoranthene	6.1E-06	6.1E-06	1.2E-05				1.2E-05
Benzo(k)fluoranthene	3.2E-06	3.2E-06	6.4E-06				6.4E-06
Chlordane, total	1.2E-04	1.2E-05	1.3E-04				1.3E-04
Chrysene	6.1E-06	6.1E-06	1.2E-05				1.2E-05
DDD, p,p'-	6.6E-04	5.8E-05	7.2E-04				7.2E-04
DDT, p,p'-	1.8E-04	1.6E-05	2.0E-04				2.0E-04
Dibenzo(a,h)anthracene							
Indeno(1,2,3-cd)pyrene	3.2E-06	3.2E-06	6.6E-06				6.6E-06
Manganese				3.7E-04	1.1E-05	3.7E-04	3.7E-04
TOTAL	9.9E-04	1.2E-04	1.1E-03	3.7E-04	1.1E-05	3.7E-04	1.5E-03

FT SHERIDAN  
NONCARCINOGENIC HAZARD INDICES  
FUTURE RECREATIONAL A

Zone JRAV BACKGROUND; Child Recreational; Chronic

ANALYTE	MEDIUM							
	Sediment					Surface Water		GRAND TOTAL
	PATHWAY		TOTAL	PATHWAY		TOTAL		
	Dermal	Oral		Dermal	Oral			
Benzo(a)anthracene	5.7E-05	5.7E-05	1.1E-04				1.1E-04	
Benzo(a)pyrene	5.7E-05	5.7E-05	1.1E-04				1.1E-04	
Benzo(b)fluoranthene	5.7E-05	5.7E-05	1.1E-04				1.1E-04	
Benzo(k)fluoranthene	2.9E-05	2.9E-05	6.0E-05				6.0E-05	
Chlordane, total	2.2E-04	1.1E-04	3.3E-04				3.3E-04	
Chrysene	5.7E-05	5.7E-05	1.1E-04				1.1E-04	
DDD, P,p'-	1.2E-03	5.5E-04	1.8E-03				1.8E-03	
DDT, P,p'-	3.3E-04	1.5E-04	4.9E-04				4.9E-04	
Dibenzo(a,h)anthracene								
Indeno(1,2,3-cd)pyrene	3.0E-05	3.0E-05	6.0E-05				6.0E-05	
Manganese				6.7E-04	5.1E-05	7.2E-04	7.2E-04	
TOTAL	2.0E-03	1.1E-03	3.1E-03	6.7E-04	5.1E-05	7.2E-04	3.8E-03	

FT SHERIDAN  
NONCARCINOGENIC HAZARD INDICES  
FUTURE RECREATIONAL B

Zone Beach BACKGROUND; Adult Recreational; Chronic

ANALYTE	MEDIUM						
	Sediment			Surface Water			
	PATHWAY		TOTAL	PATHWAY		TOTAL	GRAND TOTAL
	Derma	Oral		Derma	Oral		
Arsenic	1.3E-03	2.1E-03	3.3E-03				3.3E-03
Beryllium							
Chloroform							
Manganese	8.7E-03	1.3E-03	1.0E-02	7.1E-04	2.2E-05	7.6E-04	1.1E-02
Sulfate							
TOTAL	1.0E-02	3.4E-03	1.3E-02	7.1E-04	2.2E-05	7.6E-04	1.4E-02



FT SHERIDAN  
NONCARCINOGENIC HAZARD INDICES  
FUTURE RECREATIONAL B

Zone Beach BACKGROUND; Child Recreational; Chronic

ANALYTE	MEDIUM							GRAND TOTAL
	Sediment			Surface Water				
	PATHWAY		TOTAL	PATHWAY		TOTAL		
	Dermal	Oral		Dermal	Oral			
Arsenic	2.4E-03	1.9E-02	2.2E-02					2.2E-02
Beryllium								
Choroform								
Manganese	1.6E-02	1.2E-02	2.8E-02	5.4E-03	4.1E-04	6.0E-03		3.4E-02
Sulfate								
TOTAL	1.8E-02	3.1E-02	4.9E-02	5.4E-03	4.1E-04	6.0E-03		5.5E-02

## **Appendix J**

### **Hardness Data Used in Adjusting Surface Water and Groundwater Screening Criteria**

Medium	Study Area	Site ID	Concentration	Units
Groundwater	Beach	LF2MW04S	28.0	mg/L
		LF2MW08D	88.4	mg/L
		LF2MW04D	92.4	mg/L
		LF2MW07D	140.0	mg/L
		LF2MW08D	148.0	mg/L
		LF2MW09D	148.0	mg/L
		LF2MW07S	152.0	mg/L
		LF2MW04D	162.0	mg/L
		LF2MW04D	164.0	mg/L
		LF2MW05S	178.0	mg/L
		LF2MW05D	224.0	mg/L
		LF2MW01	228.0	mg/L
		LF2MW07D	228.0	mg/L
		LF2MW01	236.0	mg/L
		LF2MW01	242.0	mg/L
		LF2MW05D	248.0	mg/L
		LF2MW09D	248.0	mg/L
		LF2MW06D	252.0	mg/L
		LF2MW01	256.0	mg/L
		LF2MW09D	256.0	mg/L
		LF2MW05D	356.0	mg/L
		LF2MW06D	364.0	mg/L
		LF2MW06D	380.0	mg/L
		LF2MW10	404.0	mg/L
		LF2MW10	432.0	mg/L
		LF2MW11	508.0	mg/L
		LF2MW06D	520.0	mg/L
		LF2MW09S	580.0	mg/L
		LF2MW09S	632.0	mg/L
		LF2MW08S	700.0	mg/L
		LF2MW07S	712.0	mg/L
		LF2MW09S	716.0	mg/L
		LF2MW11	716.0	mg/L
		LF2MW11	806.0	mg/L
		LF2MW04S	818.0	mg/L
		LF2MW06S	822.0	mg/L
		LF2MW09S	825.0	mg/L
		LF2MW06S	844.0	mg/L
		LF2MW07S	850.0	mg/L
		LF2MW08D	856.0	mg/L
		LF2MW02	860.0	mg/L
		LF2MW05S	880.0	mg/L
		LF2MW06S	888.0	mg/L
		LF2MW02	908.0	mg/L
		LF2MW02	960.0	mg/L
		LF2MW08S	978.0	mg/L
		LF2MW06S	995.0	mg/L
		LF2MW06S	1010.0	mg/L
		LF2MW08S	1020.0	mg/L
		LF2MW06S	1100.0	mg/L
		LF2MW05S	1150.0	mg/L
		LF2MW08S	1200.0	mg/L
		LF2MW04S	1320.0	mg/L
		LF2MW02	3290.0	mg/L
		LF2MW02	4400.0	mg/L
Surface Water	Beach	C-0690	444.0	mg/L
		OD-1	450.0	mg/L
		C-0692	530.0	mg/L
		C-0300	748.0	mg/L
Surface Water	Hutchinson Ravine	HRSW03	504.0	mg/L
		HRBSW05	529.0	mg/L
		HRBSW05	533.0	mg/L
		HRBSW04	536.0	mg/L
		HRSW03	538.0	mg/L
		HRBSW03	550.0	mg/L
		HRBSW02	561.0	mg/L
		HRBSW01	585.0	mg/L

Medium	Study Area	Site ID	Concentration	Units
Surface Water	Hutchinson Ravine	HRSW02	656.0	mg/L
		HRSW01	714.0	mg/L
		C-0732	722.0	mg/L
Surface Water	Janes Ravine	C-0130	321.0	mg/L
		C-0031	498.0	mg/L
		JRBSW02	594.0	mg/L
		JRBSW01	597.0	mg/L
		JRSW02	614.0	mg/L
		JRBSW03	744.0	mg/L

Q:\EAT\_SYS\USERS\COMMON\FTSHERID\OU2REV\MARY\HARDNESS.LST

## **Appendix K**

### **Lake Michigan Sediment Sampling**

## **Appendix K**

### **Lake Michigan Sediment Sampling**

#### **K.1 Introduction**

Sediment samples were collected from Lake Michigan during the Remedial Investigation (RI) activities conducted on both the Surplus and Department of Defense (DoD) Operable Units (OU's). The collected data from both OU's were used in the ecological risk assessment for the Surplus OU. The following paragraphs discuss the sample collection methodologies employed in collecting samples for the two OUs. In addition, a comparison of the analytical data from the sediment samples is presented.

#### **K.2 Surplus OU Lake Michigan Sediment Sampling**

The Surplus OU Lake Michigan sediment samples were collected during the fall of 1995 in accordance with the Fort Sheridan Overall Quality Assurance Project Plan (OQAPP) (ESE, 1995). Two sediment samples were collected in the littoral zone off the beach just below Landfill 2. The samples were collected by wading out from the beach approximately 10 feet, whereupon a quantity of sediment was collected in a stainless steel bowl with a hand trowel. Excess water was drained off and the remaining sediment was used to fill appropriate sample containers. The samples were logged, preserved, and shipped to the laboratory in accordance with the protocols set forth in the OQAPP. The Lake Michigan samples were analyzed for the presence of metals, polynuclear aromatic hydrocarbons (PAHs), explosives related compounds.

#### **K.3 DoD OU Lake Michigan Sediment Sampling**

The DoD OU Lake Michigan sediment samples were collected in May of 1997 in accordance with the Fort Sheridan OQAPP, as amended. Sediment samples were collected using an Eckman dredge. The Eckman dredge was lowered from the bow of the boat by rope and settled into the sediment layer. When the device was pulled to the surface, the mouth of the Eckman dredge closed, collecting sediments in the dredge. Sediments were taken out of the device with a stainless steel spoon and a VOC fraction was placed directly into a sample jar. The remaining fractions were homogenized in a stainless steel bowl. Twenty sediment samples were collected from Lake Michigan with six samples obtained north of Fort Sheridan at Lake Forest; six samples collected offshore from Landfill 7; four samples collected offshore south of Shenck Ravine and near the southern installation boundary; and offshore samples collected at the mouths of Hutchinson, Bartlett, and Van Horne Ravines. The offshore samples were collected along transects oriented perpendicular to the beach at distances of 30 and 70 feet offshore. The location from which the samples were collected are depicted in Figure 1.

#### **K.4 Surplus and DoD OU Lake Michigan Sediment Data Comparison**

The following paragraphs present a comparison of the Surplus OU and the DoD OU data and exposure point concentration calculations for the constituents aluminum and 1,3-dinitrobenzene detected in the DoD OU Lake Michigan sediment samples.

## Aluminum

### Sediments

Summary statistics of aluminum concentrations for DOD and Surplus OU sediment samples are provided in Table 1.

Table 1. Summary Statistics for Sediments-Lake Michigan

Number of samples	20
Frequency of detection	100 percent
Minimum concentration	1,430 $\mu\text{g/g}$
Maximum concentration	3,100 $\mu\text{g/g}$
Mean concentration	2,398 $\mu\text{g/g}$
Standard deviation	$\pm 527 \mu\text{g/g}$
95% UCL	2,614 $\mu\text{g/g}$

Source: SAIC

The concentrations of aluminum in the two Surplus OU samples, TRSD01 and TRSD02, were at the low end of the range of aluminum concentrations for all Lake Michigan sediment samples. Aluminum concentrations were 1,450 and 1,430  $\mu\text{g/g}$  in Samples TRSD01 and TRSD02, respectively (Table 2; note that the table also includes the values measured in duplicate samples). Aluminum concentrations reported for the DoD OU sediment samples ranged from 1,450 to 3,100  $\mu\text{g/g}$ .

### Surface water

Three lake surface water samples were collected during the DoD OU RI (see Table 2). Aluminum concentrations ranged from 173 to 1,460  $\mu\text{g/L}$ .

## 1,3 Dinitrobenzene

### Sediments

The only Lake Michigan sediment sample in which 1,3 dinitrobenzene was detected was Sample TRSD02 at a concentration of 0.297  $\mu\text{g/g}$ .

Table 2. Sediment and Surface Water Aluminum Concentrations-Lake Michigan

DATE	CASE	SITEID	SAMPNO	DEPTH	TYPE	CLASS	CMPD	UNITS	CONC	COMMENT
16-May-97	1	WLF701	SAIC01		0 WATER	METAL	AL	UG/L	230	
16-May-97	2	SWNORTH1	SAIC01		0 WATER	METAL	AL	UG/L	173	
16-May-97	3	SWSOUTH1	SAIC01		0 WATER	METAL	AL	UG/L	1460	
24-Oct-95	4	TRSD01	SNP2SD1		0 SED	METAL	AL	UG/G	1450	
24-Oct-95	5	TRSD02	SNP2SD2		0 SED	METAL	AL	UG/G	1430	
16-May-97	6	SDLMBAR1	SAIC01		0 SED	METAL	AL	UG/G	2180	
16-May-97	7	SDLMHUT1	SAIC01		0 SED	METAL	AL	UG/G	2270	G
16-May-97	8	SDLMJAN1	SAIC01		0 SED	METAL	AL	UG/G	3010	
16-May-97	9	SDLMLF71	SAIC01		0 SED	METAL	AL	UG/G	1450	G
16-May-97	10	SDLMLF72	SAIC01		0 SED	METAL	AL	UG/G	2250	G
16-May-97	11	SDLMLF73	SAIC01		0 SED	METAL	AL	UG/G	2730	G
16-May-97	12	SDLMLF74	SAIC01		0 SED	METAL	AL	UG/G	2700	G
16-May-97	13	SDLMLF75	SAIC01		0 SED	METAL	AL	UG/G	2290	G
16-May-97	14	SDLMLF75	SAIC01D		0 SED	METAL	AL	UG/G	2830	D
16-May-97	15	SDLMLF76	SAIC01		0 SED	METAL	AL	UG/G	2520	G
16-May-97	16	SDLMVHR1	SAIC01		0 SED	METAL	AL	UG/G	2460	G
16-May-97	17	SDNORTH1	SAIC01		0 SED	METAL	AL	UG/G	2370	
16-May-97	18	SDNORTH2	SAIC01		0 SED	METAL	AL	UG/G	2540	
16-May-97	19	SDNORTH3	SAIC01		0 SED	METAL	AL	UG/G	2630	
16-May-97	20	SDNORTH4	SAIC01		0 SED	METAL	AL	UG/G	2690	
16-May-97	21	SDNORTH5	SAIC01		0 SED	METAL	AL	UG/G	2120	
16-May-97	22	SDNORTH6	SAIC01		0 SED	METAL	AL	UG/G	2680	
16-May-97	23	SDSOUTH1	SAIC01		0 SED	METAL	AL	UG/G	2740	G
16-May-97	24	SDSOUTH2	SAIC01		0 SED	METAL	AL	UG/G	2080	G
16-May-97	25	SDSOUTH3	SAIC01		0 SED	METAL	AL	UG/G	2790	G
16-May-97	26	SDSOUTH3	SAIC01D		0 SED	METAL	AL	UG/G	3100	D
16-May-97	27	SDSOUTH4	SAIC01		0 SED	METAL	AL	UG/G	2890	G



Table 2. Sediment and Surface Water Aluminum Concentrations-Lake Michigan

DATE	CASE	SITEID	SAMPNO	DEPTH	TYPE	CLASS	CMPD	UNITS	CONC	COMMENT
16-May-97		1 WLF701	SAIC01		0 WATER	METAL	AL	UG/L	230	
16-May-97		2 SWNORTH1	SAIC01		0 WATER	METAL	AL	UG/L	173	
16-May-97		3 SWSOUTH1	SAIC01		0 WATER	METAL	AL	UG/L	1460	
24-Oct-95		4 TRSD01	SNP2SD1		0 SED	METAL	AL	UG/G	1450	
24-Oct-95		5 TRSD02	SNP2SD2		0 SED	METAL	AL	UG/G	1430	
16-May-97		6 SDLMBAR1	SAIC01		0 SED	METAL	AL	UG/G	2180	
16-May-97		7 SDLMHUT1	SAIC01		0 SED	METAL	AL	UG/G	2270 G	
16-May-97		8 SDLMJAN1	SAIC01		0 SED	METAL	AL	UG/G	3010	
16-May-97		9 SDLMLF71	SAIC01		0 SED	METAL	AL	UG/G	1450 G	
16-May-97		10 SDLMLF72	SAIC01		0 SED	METAL	AL	UG/G	2250 G	
16-May-97		11 SDLMLF73	SAIC01		0 SED	METAL	AL	UG/G	2730 G	
16-May-97		12 SDLMLF74	SAIC01		0 SED	METAL	AL	UG/G	2700 G	
16-May-97		13 SDLMLF75	SAIC01		0 SED	METAL	AL	UG/G	2290 G	
16-May-97		14 SDLMLF75	SAIC01D		0 SED	METAL	AL	UG/G	2830 D	
16-May-97		15 SDLMLF76	SAIC01		0 SED	METAL	AL	UG/G	2520 G	
16-May-97		16 SDLMVHR1	SAIC01		0 SED	METAL	AL	UG/G	2460 G	
16-May-97		17 SDNORTH1	SAIC01		0 SED	METAL	AL	UG/G	2370	
16-May-97		18 SDNORTH2	SAIC01		0 SED	METAL	AL	UG/G	2540	
16-May-97		19 SDNORTH3	SAIC01		0 SED	METAL	AL	UG/G	2630	
16-May-97		20 SDNORTH4	SAIC01		0 SED	METAL	AL	UG/G	2690	
16-May-97		21 SDNORTH5	SAIC01		0 SED	METAL	AL	UG/G	2120	
16-May-97		22 SDNORTH6	SAIC01		0 SED	METAL	AL	UG/G	2680	
16-May-97		23 SDSOUTH1	SAIC01		0 SED	METAL	AL	UG/G	2740 G	
16-May-97		24 SDSOUTH2	SAIC01		0 SED	METAL	AL	UG/G	2080 G	
16-May-97		25 SDSOUTH3	SAIC01		0 SED	METAL	AL	UG/G	2790 G	
16-May-97		26 SDSOUTH3	SAIC01D		0 SED	METAL	AL	UG/G	3100 D	
16-May-97		27 SDSOUTH4	SAIC01		0 SED	METAL	AL	UG/G	2890 G	

Source:SAIC

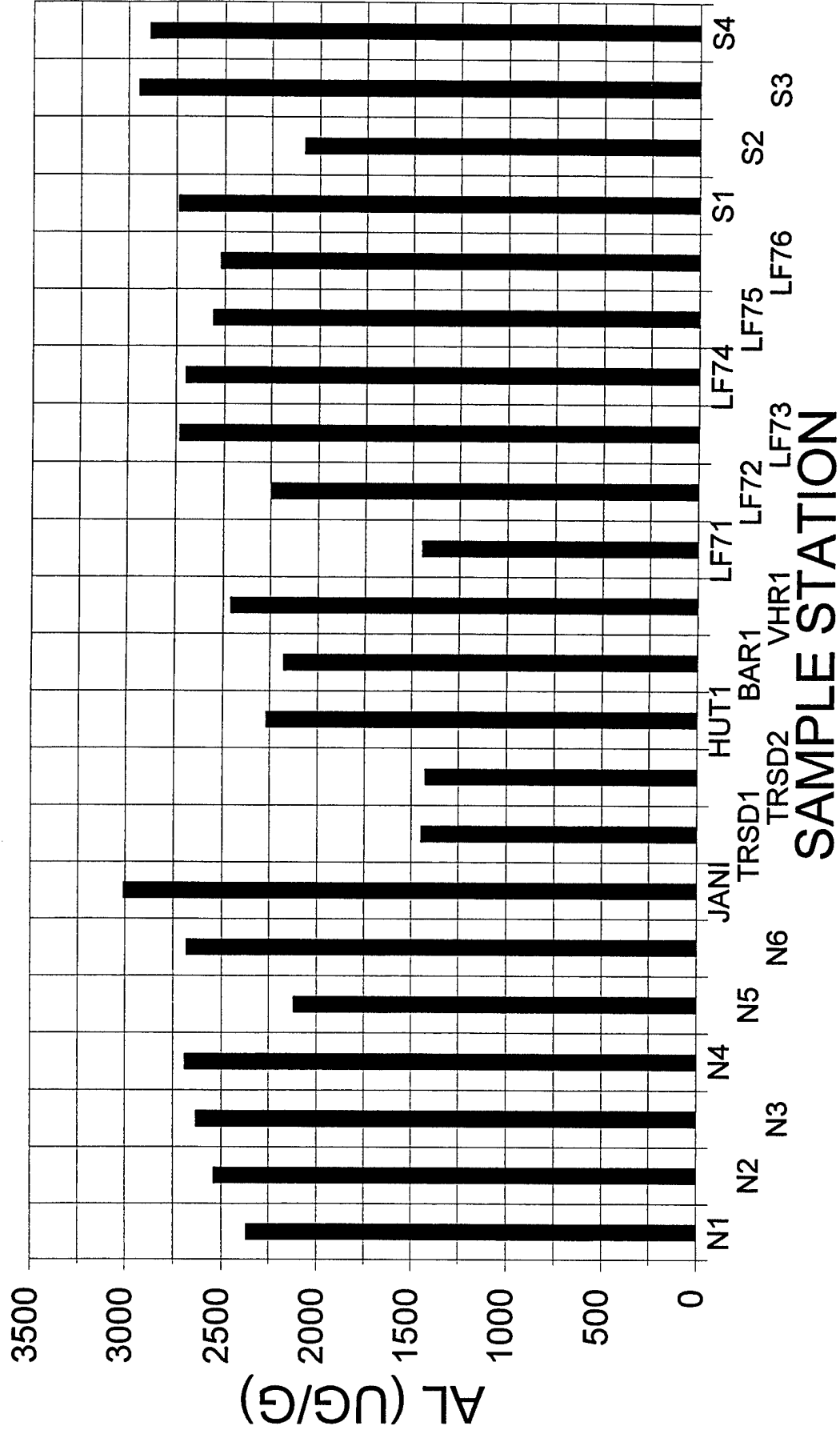
Table 2. Sediment and Surface Water Aluminum Concentrations-Lake Michigan

DATE	CASE	SITEID	SAMPNO	DEPTH	TYPE	CLASS	CMPD	UNITS	CONC	COMMENT
16-May-97		1WLF701	SAIC01		0 WATER	METAL	AL	UG/L	230	
16-May-97		2SWNORTH1	SAIC01		0 WATER	METAL	AL	UG/L	173	
16-May-97		3SWSOUTH1	SAIC01		0 WATER	METAL	AL	UG/L	1460	
24-Oct-95		4TRSD01	SNP2SD1		0 SED	METAL	AL	UG/G	1450	
24-Oct-95		5TRSD02	SNP2SD2		0 SED	METAL	AL	UG/G	1430	
16-May-97		6SDLMBAR1	SAIC01		0 SED	METAL	AL	UG/G	2180	
16-May-97		7SDLMHUT1	SAIC01		0 SED	METAL	AL	UG/G	2270	G
16-May-97		8SDLMJAN1	SAIC01		0 SED	METAL	AL	UG/G	3010	
16-May-97		9SDLMLF71	SAIC01		0 SED	METAL	AL	UG/G	1450	G
16-May-97		10SDLMLF72	SAIC01		0 SED	METAL	AL	UG/G	2250	G
16-May-97		11SDLMLF73	SAIC01		0 SED	METAL	AL	UG/G	2730	G
16-May-97		12SDLMLF74	SAIC01		0 SED	METAL	AL	UG/G	2700	G
16-May-97		13SDLMLF75	SAIC01		0 SED	METAL	AL	UG/G	2290	G
16-May-97		14SDLMLF75	SAIC01D		0 SED	METAL	AL	UG/G	2830	D
16-May-97		15SDLMLF76	SAIC01		0 SED	METAL	AL	UG/G	2520	G
16-May-97		16SDLMVHR1	SAIC01		0 SED	METAL	AL	UG/G	2460	G
16-May-97		17SDNORTH1	SAIC01		0 SED	METAL	AL	UG/G	2370	
16-May-97		18SDNORTH2	SAIC01		0 SED	METAL	AL	UG/G	2540	
16-May-97		19SDNORTH3	SAIC01		0 SED	METAL	AL	UG/G	2630	
16-May-97		20SDNORTH4	SAIC01		0 SED	METAL	AL	UG/G	2690	
16-May-97		21SDNORTH5	SAIC01		0 SED	METAL	AL	UG/G	2120	
16-May-97		22SDNORTH6	SAIC01		0 SED	METAL	AL	UG/G	2680	
16-May-97		23SDSOUTH1	SAIC01		0 SED	METAL	AL	UG/G	2740	G
16-May-97		24SDSOUTH2	SAIC01		0 SED	METAL	AL	UG/G	2080	G
16-May-97		25SDSOUTH3	SAIC01		0 SED	METAL	AL	UG/G	2790	G
16-May-97		26SDSOUTH3	SAIC01D		0 SED	METAL	AL	UG/G	3100	D
16-May-97		27SDSOUTH4	SAIC01		0 SED	METAL	AL	UG/G	2890	G

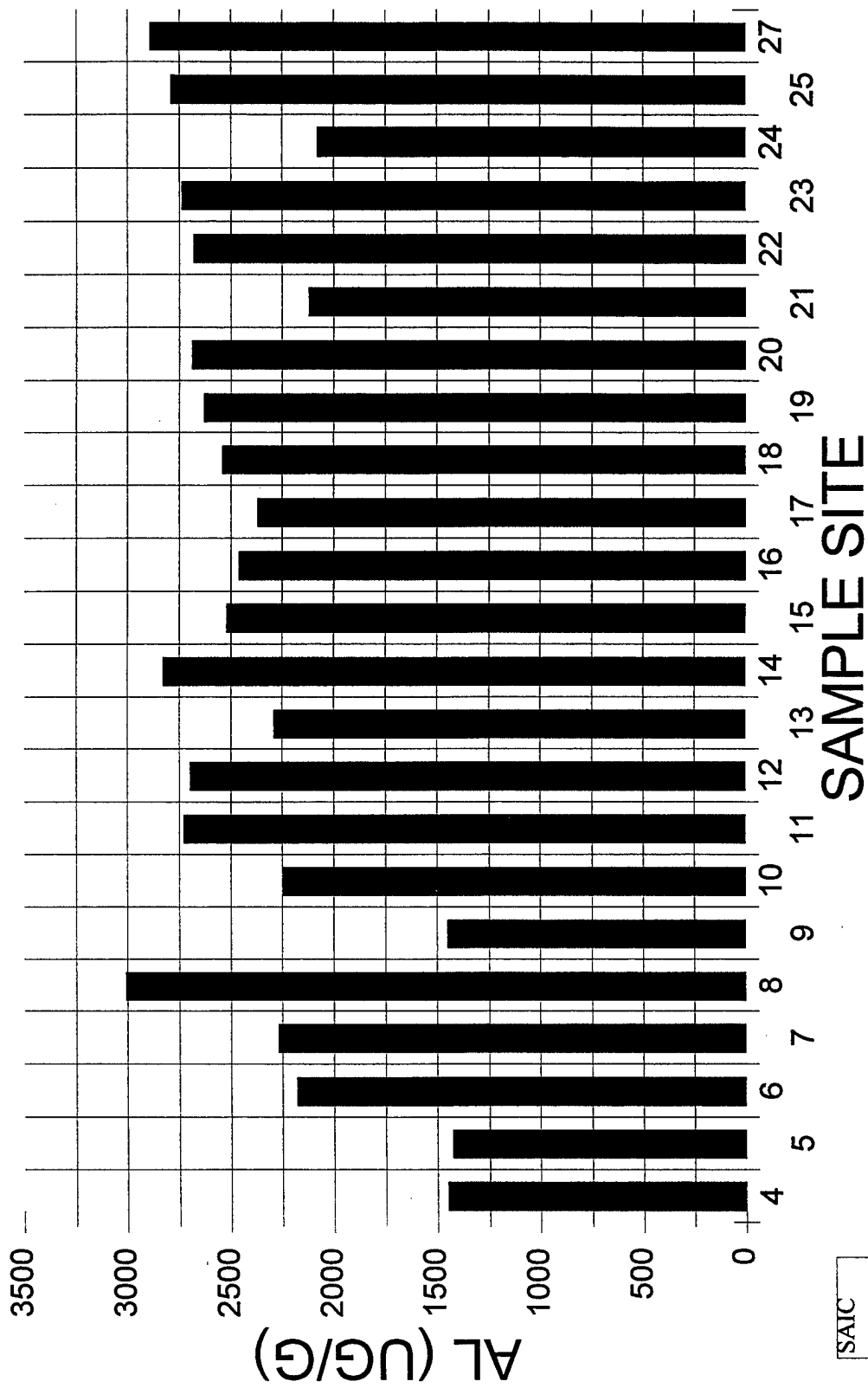
Source:SAIC

# LAKE MICHIGAN SEDIMENTS

ALUMINUM



# LAKE MICHIGAN SEDIMENTS ALUMINUM



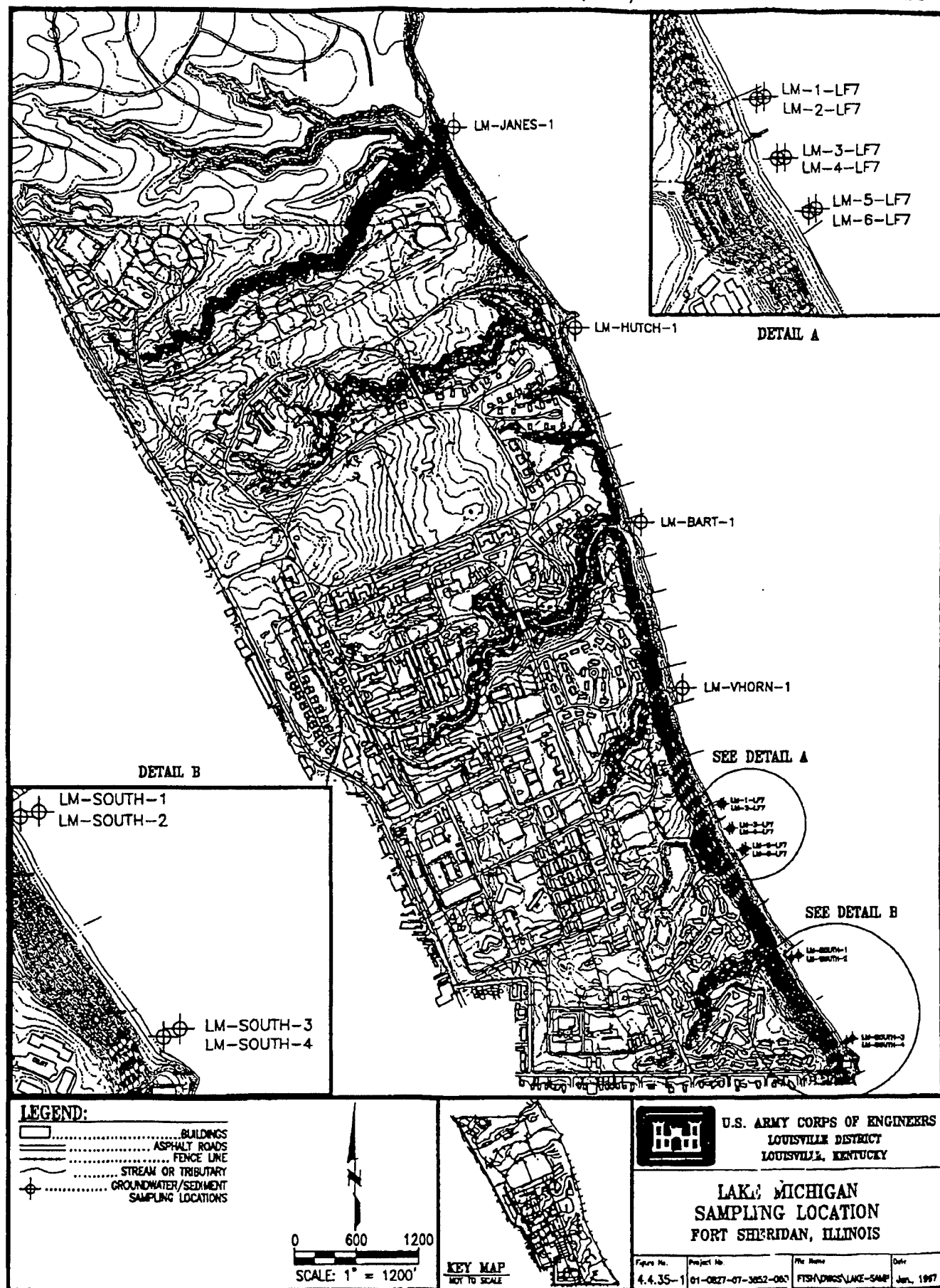


Figure 1

Table 4.4.35-1. Lake Michigan Surface Water Analytical Results Summary  
Fort Sheridan, Illinois

Site ID	W-LF7-01	SW-NORTH-1	SW-SOUTH-1
Field Sample Number	SAIC01	SAIC01	SAIC01
Site Type	LAKE	LAKE	LAKE
Collection Date	5/16/97	5/16/97	5/16/97
Depth (ft)	0	0	0

<b>VOLATILES</b>	
Laboratory Id Number	
Parameter	Units
Methylene Chloride	µg/L
Toluene	µg/L
	LT
	1.00
	1.20
	2.30 G+
	0.720 JP

<b>SEMI-VOLATILES</b>	
Laboratory Id Number	
Parameter	Units
di-N-Butyl Phthalate	µg/L
	2.40
	2.40

<b>METALS</b>	
Laboratory Id Number	
Parameter	Units
Aluminum	µg/L
Arsenic	µg/L
Boron	µg/L
Berium	µg/L
Beryllium	µg/L
Calcium	µg/L
Iron	µg/L
Potassium	µg/L
Magnesium	µg/L
Manganese	µg/L
Molybdenum	µg/L
Sodium	µg/L
Vanadium	µg/L
Zinc	µg/L
	LT
	230
	2.50
	55.1
	20.9 JP8
	0.976 JP8+
	38100
	413
	1480 B
	12700
	16.8
	10.0
	7390
	1.58 JP
	11.4 JP
	173
	1.15 JP
	47.9 JP
	20.9 JP8
	0.981 JP8+
	34700
	218
	1420 B
	11300
	6.57
	7.20 JP
	6980
	5.00
	12.2 JP
	1480
	2.50
	60.1
	26.2 B
	1.08 JP8+
	39500
	1580
	2150 B
	13800
	34.1
	10.7
	7570
	5.10
	18.1 JP

<b>PESTICIDES</b>	
Laboratory Id Number	
Parameter	Units
Endrin Aldehyde	µg/L
	0.15 BU
	0.100 BU
	0.031 BU

<b>EXPLOSIVES</b>	
Laboratory Id Number	
Parameter	Units
HMX	µg/L
	LT
	0.160
	0.160
	0.0213 JP

Table 4.4.35-2. Summary Statistics and Exposure Point Concentrations for Sediment - Lake Michigan  
Phase II RI/FS, U.S. DOD OU, Fort Sheridan, Illinois

Parameter	Unit	Total Number of Samples	Total Number of Dates	Frequency of Detection	Min CRL	Max CRL	Minimum	Maximum	Arithmetic Mean	Standard Deviation	Distribution <sup>a</sup>	95% UCL of Arithmetic Mean	Exposure Point Concentration <sup>b</sup>	Screening Status <sup>c</sup>
Aluminum	ppb	18	18	100%	..	..	1,430	3,100	2,398	537	Normal	2,614	2,614	(M) (U) (mg)
Antic	ppb	18	18	100%	..	..	1.9	3.0	2.5	0.31	Normal	2.6	2.6	(M)
Barium	ppb	18	18	89%	46	46	4.8	17	10	3.9	Normal	17	12	(M) (U) (mg)
Beryllium	ppb	18	11	61%	0.056	0.50	0.10	0.24	0.079	0.079	Normal	0.18	0.18	(M)
Boron	ppb	16	12	71%	3.9	9.8	6.3	12	7.8	2.8	Normal	9.8	9.8	(M) (U) (mg)
Cadmium	ppb	18	5	28%	0.36	0.50	0.42	0.64	0.32	0.12	Normal	0.37	0.37	(M) (U) (mg)
Calcium	ppb	18	18	100%	..	..	35,100	66,000	51,478	17,984	Normal	58,832	58,832	(M) (U) (mg)
Chromium	ppb	18	18	100%	..	..	4.1	13	7.2	2.5	Normal	8.2	8.2	(M) (U) (mg)
Cobalt	ppb	18	18	89%	2.0	2.0	1.9	3.6	2.7	0.79	Normal	3.6	3.6	(M) (U) (mg)
Copper	ppb	18	18	100%	..	..	5.6	12	5.1	1.9	Normal	5.9	5.9	(M) (U) (mg)
Iron	ppb	18	18	100%	..	..	5,280	16,100	8,904	2,954	Normal	10,115	10,115	(M) (U) (mg)
Lead	ppb	18	18	100%	..	..	3.8	14	7.4	2.8	Normal	8.5	8.5	(M) (U) (mg)
Magnesium	ppb	18	18	100%	..	..	11,400	41,700	24,938	9,375	Normal	29,046	29,046	(M) (U) (mg)
Manganese	ppb	18	18	100%	..	..	148	340	219	52	Normal	240	240	(M) (U) (mg)
Molybdenum	ppb	16	11	69%	1.00	1.00	0.87	2.4	1.7	0.58	Normal	1.4	1.4	(M) (U) (mg)
Nickel	ppb	18	18	100%	..	..	4.4	7.7	5.5	0.90	Normal	5.9	5.9	(M) (U) (mg)
Phosphorus	ppb	18	18	100%	..	..	254	590	472	94	Normal	511	511	(M) (U) (mg)
Selenium	ppb	18	18	100%	..	..	161	541	394	102	Normal	418	418	(M) (U) (mg)
Tin	ppb	16	4	25%	5.0	5.0	4.7	6.4	3.3	1.5	Normal	4.0	4.0	(M) (U) (mg)
Vanadium	ppb	18	18	100%	..	..	7.1	71	29	17	Normal	36	36	(M) (U) (mg)
Zinc	ppb	18	18	100%	..	..	18	61	41	14	Normal	46	46	(M) (U) (mg)
1,3-Dichlorobenzene	ppb	18	1	6%	0.100	0.25	0.36	0.30	0.068	0.040	Normal	0.092	0.092	(M) (U) (mg)
4,4'-DDE	ppb	16	16	100%	..	..	0.0071	0.011	0.0041	0.0022	Normal	0.0031	0.0031	(M) (U) (mg)
4,4'-DDD	ppb	16	16	100%	..	..	0.0087	0.0041	0.0014	0.00078	Normal	0.0017	0.0017	(M) (U) (mg)
4,4'-DDT	ppb	16	12	75%	0.0077	0.0016	0.00095	0.0085	0.0019	0.0019	Normal	0.0027	0.0027	(M) (U) (mg)
Aroclor	ppb	16	14	85%	0.0004	0.0004	0.0004	1.00	0.24	0.35	Lognormal	3.4	1.00	(M) (U) (mg)
Atrazine	ppb	16	11	69%	0.0003	0.0003	0.00030	0.00069	0.00048	0.00015	Normal	0.00055	0.00055	(M) (U) (mg)
Benz(a)anthracene	ppb	18	2	11%	0.14	0.14	0.0019	0.0029	0.002	0.022	Normal	0.0019	0.0019	(M) (U) (mg)
Benz(b)fluoranthene	ppb	18	2	11%	0.14	0.14	0.0017	0.0028	0.002	0.022	Normal	0.0018	0.0018	(M) (U) (mg)
Benz(k)fluoranthene	ppb	18	3	11%	0.14	0.14	0.0027	0.0036	0.003	0.022	Normal	0.0036	0.0036	(M) (U) (mg)
Benz(a)pyrene	ppb	18	2	11%	0.14	0.14	0.0011	0.0015	0.002	0.022	Normal	0.0015	0.0015	(M) (U) (mg)
Benz(a)anthracene	ppb	18	8	50%	0.14	0.14	0.014	0.016	0.016	0.025	Normal	0.027	0.027	(M) (U) (mg)
Benz(a)anthracene	ppb	18	1	6%	0.0007	0.14	0.014	0.014	0.003	0.020	Normal	0.021	0.021	(M) (U) (mg)
Chrysene	ppb	18	13	94%	0.00044	0.00044	0.00033	0.00060	0.00040	9.11E-05	Normal	0.00044	0.00044	(M) (U) (mg)
Dibenz(a,h)anthracene	ppb	16	2	12%	0.0100	0.0100	0.016	0.016	0.0064	0.0039	Normal	0.0081	0.0081	(M) (U) (mg)
Dibenz(a,h)anthracene	ppb	16	3	19%	0.00031	0.00031	0.00033	0.00046	0.00035	0.00016	Normal	0.00042	0.00042	(M) (U) (mg)
Dibenz(a,h)anthracene	ppb	16	6	38%	0.00037	0.00037	0.00036	0.00049	0.00046	0.00012	Normal	0.00051	0.00051	(M) (U) (mg)
Dibenz(a,h)anthracene	ppb	16	16	100%	..	..	0.00037	0.00060	5.51E-05	5.51E-05	Normal	0.00052	0.00052	(M) (U) (mg)
Dibenz(a,h)anthracene	ppb	16	4	25%	0.00100	0.00100	0.00035	0.00019	0.00047	5.66E-05	Normal	0.00049	0.00049	(M) (U) (mg)
Dibenz(a,h)anthracene	ppb	18	10	56%	0.14	0.14	0.0047	0.023	0.019	0.029	Normal	0.031	0.031	(M) (U) (mg)
Dibenz(a,h)anthracene	ppb	16	7	44%	0.00031	0.00031	0.00019	0.00078	0.00044	0.00012	Normal	0.00033	0.00033	(M) (U) (mg)
Dibenz(a,h)anthracene	ppb	16	16	100%	..	..	0.00019	0.00051	0.00037	6.97E-05	Normal	0.00041	0.00041	(M) (U) (mg)
Dibenz(a,h)anthracene	ppb	18	1	6%	0.00033	0.14	0.0039	0.0039	0.003	0.022	Normal	0.021	0.021	(M) (U) (mg)
Dibenz(a,h)anthracene	ppb	16	9	56%	0.00072	0.00072	0.00069	0.00085	0.00061	0.00019	Normal	0.00069	0.00069	(M) (U) (mg)

Table 4.4.35-2. Summary Statistics and Exposure Point Concentrations for Sediment - Lake Michigan  
Phase II RI/FS, U.S. DOD OU, Fort Sheridan, Illinois

Parameter	Units	Total Number of Samples	Trials	Frequency of Detection	Min CRL	Max CRL	Min Detects	Max Detects	Arithmetic Mean	Standard Deviation	Distribution <sup>a</sup>	95% UCL of Arith. Mean	Exposure Point Concentration <sup>b</sup>	Screening Status <sup>c</sup>
Methylcyclohexane	µg/g	16	15	94%	0.0010	0.0010	0.0013	0.0019	0.0015	0.0013	Normal	0.0016	0.0016	[d-][m-]
Phenanthrene	µg/g	18	5	28%	0.033	0.14	0.013	0.015	0.050	0.026	Normal	0.061	0.073	[d-][m-]
Pyrene	µg/g	18	11	61%	0.14	0.0085	0.0085	0.069	0.042	0.026	Normal	0.033	0.033	[d-][m-]
alpha-BHC	µg/g	16	12	75%	0.00100	0.00100	0.00082	0.00097	0.00078	0.00017	Normal	0.00085	0.00085	[d-][m-]
alpha-Chlordane	µg/g	16	4	25%	0.00035	0.00100	0.00033	0.00037	0.00027	0.00012	Normal	0.00032	0.00032	[d-][m-]
beta-BHC	µg/g	16	15	94%	0.00100	0.00100	0.00042	0.00075	0.00058	0.00011	Normal	0.00063	0.00063	[d-][m-]
delta-BHC	µg/g	16	10	63%	0.0013	0.0015	0.0010	0.0014	0.00097	0.00015	Normal	0.0011	0.0011	[d-][m-]
gamma-Chlordane	µg/g	16	14	100%	..	..	0.00019	0.00024	0.00018	7.9E-05	Normal	0.00042	0.00042	[d-][m-]

<sup>a</sup> Distributions for the calculation of Upper Confidence Limits (UCLs):  
If the Lognormal Goodness-of-Fit Test Coefficient is greater than or equal to the Critical Value, the distribution is Lognormal.  
If the Normal Goodness-of-Fit Test Coefficient is greater than or equal to the Critical Value, the distribution is Normal.  
If neither of the Goodness-of-Fit Test Coefficients are greater than or equal to the Critical Value, the distribution is Lognormal.  
<sup>b</sup> For the calculation of exposure point concentrations (EPCs):  
If there are fewer than 4 samples, the EPC equals the maximum detected value of the data set.  
The EPC equals the UCL of the arithmetic mean, unless the UCL exceeds the maximum detected value. If the latter is true, the EPC equals the UCL of the detected only data set (denoted by a # flag).  
<sup>c</sup> A residue eliminated from nature and extent discussion if the maximum detected result is less than the background UTL (Bk) or less than human health screening criteria (i.e., [d-], [m-], or [p]). The human health screening criteria represent the lower of USEPA Region IX preliminary remediation goals (PRGs) or Illinois Treated Approach to Contaminative Action Objectives (TACO). 33 Illinois Admin. Code Part 742). Soil and sediment results were compared to direct contact [d-] screening values and values established for soil based on migration [m-] to groundwater. Surface water and groundwater results were compared to tap water [p] screening values (note that the lower of the Region IX or TACO Class II groundwater values were used for this comparison). For the human health risk assessment, concentrations of potential concern (COPCs) are concentrations that have not been screened out due to [d-], [m-], or [p] (i.e., [m-] was not considered), or due to the analysis of variance background screen. The background UTL (Bk) and analysis of variance background screens were the only data screens used for the ecological risk assessment.  
<sup>d</sup> The exposure point concentration (EPC) equals the UCL of the detected only data set.  
.. Not applicable (analyte not detected; statistical test is not applicable in certain cases described above; background comparison not conducted for organic compounds)  
Note: Results of duplicate analyses were averaged and nondetects were treated as one-half the detection limit in all calculations. Samples collected from the same well location were also averaged prior to being pooled for the purpose of calculating statistics.



Table 4.4.35-3. Lake Michigan Sediment Analytical Results Summary  
Fort Sheridan, Illinois

Site ID	TRSD02	TRSD01	TRSD02
Field Sample Number	SNP2SD*2	SNP2SD*1	SNP2SD*2
Site Type	LAKE	LAKE	LAKE
Collection Date	10/24/95	10/24/95	10/24/95
Depth (ft)	0	0	0

SEMIVOLATILES	
Laboratory Id Number	Units
Benzo(a)anthracene	0.00287
Benzo(a)pyrene	0.00172
Benzo(b)fluoranthene	0.00271
Benzo(k)fluoranthene	0.00105
Chrysene	0.0136
Fluoranthene	0.00894
Indeno(1,2,3-cd)pyrene	LT 0.00330
Pyrene	0.00845

METALS	
Laboratory Id Number	Units
Aluminum	1450
Arsenic	3.94
Beryllium	0.341
Calcium	54700
Chromium	4.08
Copper	6.74
Iron	8850
Lead	3.59
Manganese	360
Nickel	4.88
Potassium	307
Sodium	344
Vanadium	13.4
Zinc	36.1

EXPLOSIVES	
Laboratory Id Number	Units
1,3-Dinitrobenzene	LT 0.250
	0.287

PAGE.006

Table 4.4.35-3. Lake Michigan Sediment Analytical Results Summary  
Fort Sheridan, Illinois

Site ID	SD-LMBAR-1	SD-LMHUT-1	SD-LMAN-1	SD-LMF7-1	SD-LMF7-2	SD-LMF7-3	SD-LMF7-4
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	LAKE	LAKE	LAKE	LAKE	LAKE	LAKE	LAKE
Collection Date	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97
Depth (ft)	0	0	0	0	0	0	0

PESTICIDES	Units	0.0045 C	0.0041 C	0.0033 C	0.0030 C	0.0031 C	0.0049 C	0.0033 C
Laboratory Id Number	µg/g	0.0014 C	0.0041 C	0.0017 C	0.0011 JP	0.0011 JP	0.0011 JP	0.0011 JP
Parameter	µg/g	0.0015 C	0.0045 CG	0.0026 C	0.0016 CG	0.0017 CG	0.0016 CG	0.0015 CG
4,4'-DDD	µg/g	0.0030 JP	0.0062 JPG+	0.0067 JP	0.0052 JPG	0.0053 JPG	0.0056 JPG	0.0050 JPG
4,4'-DDE	µg/g	0.0010	0.0048 JPG+	0.0087 BJP	0.0082 BJP	0.0084 BJP	0.0089 BJP	0.0097 BJP
4,4'-DDT	µg/g	0.0047 BJP	0.0047 BJP	0.0010	0.0039 JPG+	0.0038 JPG+	0.0035 JPG+	0.0038 JPG+
Aldrin	µg/g	0.0011 BJP	0.0013 BU	0.0012 BJP	0.0010 BJP	0.0011 BJP	0.0012 BJP	0.0011 BJP
alpha-BHC	µg/g	0.0033 JP	0.0044 JPG+	0.0052 JP	0.0036 JP	0.0036 JP	0.0044 JP	0.0034 JP
beta-BHC	µg/g	0.0010	0.0034 JPG+	0.0049 JP	0.0045 JPG+	0.0045 JPG+	0.0049 JP	0.0048 JPG
delta-BHC	µg/g	0.0010	0.0037 BJP	0.0069 JP	0.0047 BJP	0.0026 JP	0.0029 JP	0.0047 JP
Dieldrin	µg/g	0.0010	0.0035 JP	0.0060 BJP	0.0047 BJP	0.0043 BJP	0.0057 BJP	0.0051 BJP
Endosulfan I	µg/g	0.0010	0.0035 JP	0.0010	0.0010	0.0010	0.0010	0.0010
Endosulfan II	µg/g	0.0010	0.0035 JP	0.0010	0.0010	0.0010	0.0010	0.0010
Endrin	µg/g	0.0010	0.0035 JP	0.0010	0.0010	0.0010	0.0010	0.0010
Endrin Ketone	µg/g	0.0029 JP	0.0034 JP	0.0033 JP	0.0036 JP	0.0030 JP	0.0040 JP	0.0035 JP
gamma-Chlordane	µg/g	0.0029 JP	0.0073 JPG+	0.0032 JP	0.0036 JPG	0.0031 JPG+	0.0031 JPG+	0.0044 JPG
Heptachlor	µg/g	0.0029 JP	0.0044 JP	0.0049 JP	0.0034 JP	0.0034 JP	0.0036 JP	0.0029 JP
Heptachlor Epoxide	µg/g	0.0071 JP	0.0075 JPG+	0.0081 JP	0.0010	0.0069 JPG	0.0072 JPG	0.0085 JPG
Lindane	µg/g	0.0030	0.0016 JP	0.0015 JP	0.0013 JP	0.0015 JP	0.0017 JP	0.0014 JP
Methoxychlor	µg/g	LT	LT	LT	LT	LT	LT	LT

HERBICIDES	Units	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
Laboratory Id Number	µg/g	0.0144 C	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
Parameter	µg/g	0.0179 C	0.0179 C	0.0179 C	0.0179 C	0.0179 C	0.0179 C	0.0179 C
Dichlorprop	µg/g	0.0144 C	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
Dinoseb	µg/g	0.0144 C	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100

**Table 4.4.35-3. Lake Michigan Sediment Analytical Results Summary  
Fort Sheridan, Illinois.**

<b>VOLATILES</b>						
Laboratory Id Number	Parameter	Units				
	Acetone	µg/g	0.9530			
		LT	0.0100	LT		
	Nelhyene Chloride	µg/g		0.230 D		
				0.0100 D		
				LT		
				0.430 B		
				0.300 B		
				0.180 B		
				0.006500 JP		
				0.000730 JPG+		
					0.0540 B	
					0.000530 JP	
					LT	
					0.0100	

[illegible]

METALS		Laboratory Id Number		Units	
Parameter	2280 G	2030 D	2520 G	2460 G	2530
Aluminum	µg/g	2.18 D	2.12	2.30	2.48
Arsenic	µg/g	12.0 JPD	7.88 JPG	8.10 JPG	9.52 JP
Barium	µg/g	0.182 JPD	0.500 G	0.131 JPG+	0.0972 JP
Beryllium	µg/g	9.17 D	9.88 G	8.94 G+	8.88
Boron	µg/g	0.500 D	0.500	0.500	0.500
Cadmium	µg/g	62000 D	48100	69000	42500
Calcium	µg/g	8.41	8.35	7.34	7.12
Chromium	µg/g	2.51 D	2.83	2.95	3.11
Cobalt	µg/g	4.20 D	3.95	11.9	6.75
Copper	µg/g	10400 D	11200 G	8820 G	6890
Iron	µg/g	6.89 D	14.0	6.13	5.71
Lead	µg/g	29400 D	23500	20800	20400
Magnesium	µg/g	230 D	217	205	225
Manganese	µg/g	1.00 D	1.87	1.41	1.38
Molybdenum	µg/g	6.07 D	5.83	5.87	5.77
Nickel	µg/g	529 D	481 G	488 G	570
Polysulfur	µg/g	483 D	394 G	320	335
Sodium	µg/g	5.00 D	5.00	5.00	5.00
Tin	µg/g	36.7 D	40.5	26.7	13.9
Vanadium	µg/g	41.9 G	42.9 G	29.7	20.9
Zinc	µg/g				

Table 4.4.35-3. Lake Michigan Sediment Analytical Results Summary  
Fort Sheridan, Illinois

Site ID	SD-LMF7-5	SD-LMF7-5	SD-LMF7-6	SD-LMF7-6	SD-LMF7-6	SD-NORTH-1	SD-NORTH-2	SD-NORTH-3
Field Sample Number	SAIC01	SAIC01D	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	LAKE	LAKE	LAKE	LAKE	LAKE	LAKE	LAKE	LAKE
Collection Date	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97
Depth (ft)	0	0	0	0	0	0	0	0

PESTICIDES	Units	0.0027 CD	0.0028 C	0.0054 C	0.0017 C	0.0025 C	0.0022 C
Laboratory Id Number							
4,4'-DDD	µg/g	0.00080 DJP	0.00098 JP	0.0014 C	0.00073 JP	0.00086 JP	0.00084 JP
4,4'-DDE	µg/g	0.0014 CD	0.0014 CG	0.0026 CG+	0.00087 JP	0.0010 JP	0.0012 C
4,4'-DDT	µg/g	0.0054 DJP	0.00089 JPG	0.0055 JPG+	0.00056 JP	0.00058 JP	0.00088 JP
Aldrin	µg/g	0.00088 BDJP	0.00091 BJP	0.00085 BJP	LT	0.00092 BJP	0.00094 BJP
alpha-BHC	µg/g	0.00037 DJP	0.00036 JPG+	0.00039 JPG+	0.00038 JP	0.00043 JP	0.00043 JP
alpha-Chlordane	µg/g	0.00069 BDJP	0.00059 BJP	0.00048 BJP	0.00060 BJP	0.00065 BJP	0.00064 BJP
beta-BHC	µg/g	0.0015 BDJ	0.0011 BJP	0.0015 BU	0.0012 BJP	0.0011 BJP	0.0012 BU
delta-BHC	µg/g	0.00041 DJP	0.00033 JP	0.00037 JP	0.00045 JP	0.0010	0.00041 JP
Dieldrin	µg/g	0.00032 JPG+	0.00031 JPG+	0.0010	0.00040 JP	0.0010	0.00035 JP
Endosulfan I	µg/g	LT	0.0010 D	0.0010	0.00056 JP	0.0010	0.00028 JP
Endosulfan II	µg/g	0.0010 D	0.00044 BJP	0.00048 BJP	0.00051 BJP	0.00047 BJP	0.00052 BJP
Endrin	µg/g	LT	0.0010	0.0010	0.0010	0.0010	0.00036 JP
Endrin Ketone	µg/g	0.00050 BDJP	0.0010	0.0010	0.0010	0.00039 JP	0.00046 JP
gamma-Chlordane	µg/g	0.00035 DJP	0.00034 JP	0.00040 JP	0.00045 JP	0.00044 JP	0.00048 JP
Heptachlor	µg/g	0.00033 DJP	0.00035 JPG+	0.00031 JPG+	0.00032 JP	0.00035 JP	0.00030 JP
Heptachlor Epoxide	µg/g	0.00034 DJP	0.00031 JP	0.00034 JP	0.00040 JP	0.00035 JP	0.00030 JP
Urethane	µg/g	0.00075 DJP	0.00078 JPG	0.00076 JPG+	0.00074 JP	0.00080 JP	0.00080 JP
Methoxychlor	µg/g	0.0014 DJP	0.0013 JP	0.0016 JP	0.0014 JP	0.0015 JP	0.0015 JP

HERBICIDES	Units	0.0100 D	0.0100 D	0.0100 D	0.0100 D	0.0100 D	0.0100 D
Laboratory Id Number							
Parameter							
Dichloroprop	µg/g	LT	0.0100 D	0.0100 D	0.0100 D	0.0100 D	0.0100 D
Dinoseb	µg/g	LT	0.0100 D	0.0100 D	0.0100 D	0.0100 D	0.0100 D

Table 4.4.35-3. Lake Michigan Sediment Analytical Results Summary  
Fort Sheridan, Illinois

Site ID	SD-NORTH-4	SD-NORTH-5	SD-NORTH-6	SD-SOUTH-1	SD-SOUTH-2	SD-SOUTH-3	SD-SOUTH-3
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01D
Site Type	LAKE	LAKE	LAKE	LAKE	LAKE	LAKE	LAKE
Collection Date	5/16/97	5/16/97	5/16/97	5/14/97	5/16/97	5/16/97	5/16/97
Depth (ft)	0	0	0	0	0	0	0

Parameter	Units	0.0360 B	0.130 B	0.400 B	0.0120 BJP	0.0100	0.0120 JPB
Acetone	µg/g	0.000850 JP	0.000650 JP	0.0100	LT	LT	0.0120 JPB
Methylene Chloride	µg/g				LT	LT	0.0100

Parameter	Units	0.0250 JP	0.140	0.0340 JP	0.0170 JP	0.140	0.140
Benzoic Acid	µg/g	LT	LT	0.100 JP	LT	LT	LT
di-N-Butyl Phthalate	µg/g	LT	LT	0.0160 JP	0.0250 JP	LT	LT
Fluoranthene	µg/g	LT	LT	0.0170 JP	0.0250 JP	LT	LT
Phenanthrene	µg/g	LT	LT	0.0150 JP	0.0250 JP	LT	LT
Pyrene	µg/g	LT	LT			LT	LT

Parameter	Units	2690	2120	2680	2740 G	2080 G	2790 G
Aluminum	µg/g	2.99	2.78	2.13	2.59	2.81	2.27
Arsenic	µg/g	8.12 JP	9.77 JP	9.34 JP	8.97 JP	8.52 JPG	9.70 JPG
Barium	µg/g	0.108 JP	0.0552 JP	0.0831 JP	0.136 JPG+	0.0555 JPG+	0.129 JPG
Beryllium	µg/g	10.4	4.59 JP	10.7	9.78 G+	3.94 JPG+	6.32 G
Boron	µg/g	0.500	0.749	0.411 JP	0.500	0.500	0.635
Cadmium	µg/g	60700	77000	60900	43200 G	25100	86000
Calcium	µg/g	6.62	5.81	5.99	7.05	4.81	8.87
Chromium	µg/g	2.43 JP	2.70	2.77	3.12	2.48	3.61
Cobalt	µg/g	3.89	5.58	9.39	4.19 G	4.26	4.25
Copper	µg/g	7240	7800	6810	7810 G	9920 G	10200 G
Iron	µg/g	10.1	11.6	8.98	8.09 G	5.13	4.86
Lead	µg/g	29100	36500	28800	20100	11400	41700
Magnesium	µg/g	220	237	217	192 G	148	257
Manganese	µg/g	1.00	1.00	0.923 JP	1.39	1.54	1.00
Molybdenum	µg/g	5.29	5.01	5.38	5.11	5.47	5.83
Nickel	µg/g	543	463	544	590 G	517 G	543 D
Potassium	µg/g	424	399	424	398 G	264	516
Sodium	µg/g	5.00	5.00	5.00	5.00	5.00	5.00
Tin	µg/g	19.8	23.0	17.0	25.3	9.39	71.1 D
Vanadium	µg/g	46.9	52.3	37.3	27.7 G	18.4	51.2
Zinc	µg/g						59.2 D

Table 4.4.35-3. Lake Michigan Sediment Analytical Results Summary  
Fort Sheridan, Illinois

Site ID	SD-NORTH-4	SD-NORTH-5	SD-NORTH-6	SD-SOUTH-1	SD-SOUTH-2	SD-SOUTH-3	SD-SOUTH-3
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01D
Site Type	LAKE	LAKE	LAKE	LAKE	LAKE	LAKE	LAKE
Collection Date	5/16/97	5/16/97	5/16/97	5/14/97	5/16/97	5/16/97	5/16/97
Depth (ft)	0	0	0	0	0	0	0

PESTICIDES	Laboratory Id Number	Units	0.0021 C	0.0014 C	0.0014 C	0.0021 C	0.0045 C	0.0033 C	0.0021 C	0.0025 CO
4,4'-DDD	0.0012 JP	µg/g	0.00072 JP	0.00077 JP	0.00085 JP	0.00085 JP	0.0017 C	0.0010 JP	0.00087 JP	0.0011 DJP
4,4'-DDE	0.00059 JP	µg/g	0.00058 JP	0.00057 JP	0.00055 JP	0.00055 JP	0.0024 C	0.0015 CG+	0.00077 JPG+	0.00095 DJP
4,4'-DDT	0.00055 JP	µg/g	0.00058 JP	0.00057 JP	0.00055 JP	0.00055 JP	0.00061 JP	0.00053 JPG+	0.00055 JPG+	0.00062 DJP
Aldrin	0.00094 BJP	µg/g	0.00094 BJP	0.00094 BJP	0.00094 BJP	0.00094 BJP	0.0010	LT	0.0010	0.00090 BDJP
alpha-BHC	0.00040 JP	µg/g	0.00033 JP	0.00033 JP	0.00035 JP	0.00035 JP	0.0010	LT	0.00035 JPG+	0.00036 DJP
beta-BHC	0.00064 BJP	µg/g	0.00057 BJP	0.00057 BJP	0.00075 BJP	0.00075 BJP	0.0010	0.00049 BJP	0.00063 BJP	0.00064 BDJP
delta-BHC	0.00092 BJP	µg/g	0.00092 BJP	0.00092 BJP	0.0013 BU	0.0013 BU	0.0014 BU	0.0012 BJP	0.0012 BJP	0.0014 BCD
Dieldrin	0.00042 JP	µg/g	0.00039 JP	0.00039 JP	0.00041 JP	0.00041 JP	0.00040 JP	0.00034 JP	0.00044 JP	0.00051 DJP
Endosulfan I	0.00047 JP	µg/g	0.00047 JP	0.00047 JP	0.00047 JP	0.00047 JP	0.0010	0.00031 JPG+	0.0010	0.0010 D
Endosulfan II	0.00055 JP	µg/g	0.00055 JP	0.00055 JP	0.00055 JP	0.00055 JP	0.0010	0.0010	0.00028 JP	0.00029 DJP
Endrin	0.00046 BJP	µg/g	0.00046 BJP	0.00046 BJP	0.00057 BJP	0.00057 BJP	0.00055 BJP	0.00050 BJP	0.00050 BJP	0.00053 BDJP
Endrin Ketone	0.00045 JP	µg/g	0.00045 JP	0.00045 JP	0.00047 JP	0.00047 JP	0.00039 JP	0.00037 JP	0.00038 JP	0.0010 O
gamma-Chlordane	0.00036 JP	µg/g	0.00036 JP	0.00036 JP	0.00036 JP	0.00036 JP	0.00039 JP	0.00039 JP	0.00036 JPG+	0.00038 DJP
Heptachlor	0.00037 JP	µg/g	0.00037 JP	0.00037 JP	0.00034 JP	0.00034 JP	0.00039 JP	0.0010	0.00036 JPG+	0.00034 DJP
Heptachlor Epoxide	0.00076 JP	µg/g	0.00072 JP	0.00072 JP	0.00047 JP	0.00047 JP	0.00051 JP	0.00031 JP	0.00041 JP	0.00045 DJP
Lindane	0.0013 JP	µg/g	0.0016 JP	0.0016 JP	0.00089 JP	0.00089 JP	0.00095 JPG+	0.00072 JPG+	0.00079 JPG+	0.00081 DJP
Methoxychlor		µg/g			0.0015 JP	0.0015 JP	0.0016 JP	0.0019 JP	0.0014 JP	0.0016 DJP

HERBICIDES	Laboratory Id Number	Units	0.0739 C	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100 D
Dichlorprop	NF	µg/g	NF	LT	LT	LT	LT	LT	LT	LT
Dinoseb	NF	µg/g	NF	LT	LT	LT	LT	LT	LT	LT

Table 4.4.35-3. Lake Michigan Sediment Analytical Results Summary  
Fort Sheridan, Illinois

Site ID	SD-SOUTH-4
Field Sample Number	SAK01
Site Type	LAKE
Collection Date	5/16/97
Depth (ft)	0

VOLATILES		
Laboratory Id Number	Units	
Parameter	µg/g	
Acetone	µg/g	0.0100 JPB
Methylene Chloride	LT	0.0100

SEMIVOLATILES		
Laboratory Id Number	Units	
Parameter	µg/g	
Benzoic Acid	LT	0.140
di-N-Butyl Phthalate	LT	0.140
Fluoranthene	LT	0.140
Phenanthrene	LT	0.140
Pyrene	LT	0.140

METALS		
Laboratory Id Number	Units	
Parameter	µg/g	
Aluminum	µg/g	2850 G
Arsenic	µg/g	2.77
Barium	µg/g	8.85 JPB
Beryllium	µg/g	0.500
Boron	LT	10.2 G
Cadmium	µg/g	0.500
Calcium	µg/g	80000
Chromium	µg/g	11.4
Cobalt	µg/g	3.42
Copper	µg/g	3.99
Iron	µg/g	14800 G
Lead	µg/g	11.3
Magnesium	µg/g	36580
Manganese	µg/g	256
Molybdenum	µg/g	1.20 JP
Nickel	µg/g	7.02
Potassium	µg/g	488 G
Sodium	µg/g	532
Tin	LT	5.00
Vanadium	µg/g	61.8
Zinc	µg/g	53.8



Table 4.4.35-3. Lake Michigan Sediment Analytical Results Summary  
Fort Sheridan, Illinois

Site ID	SD-SOUTH-4
Field Sample Number	SAIC01
Site Type	LAKE
Collection Date	5/16/97
Depth (ft)	0

PESTICIDES	
Laboratory Id Number	Units
4,4'-DDD	0.0024 C
4,4'-DDE	0.0010 JP
4,4'-DDT	0.0012 JPG+
Aldrin	0.0056 JPG+
alpha-BHC	0.0088 BJP
alpha-Chlordane	0.0035 JPG+
beta-BHC	0.0047 BJP
delta-BHC	0.0013 BU
Dieldrin	0.0037 JP
Endosulfan I	LT 0.0010
Endosulfan II	LT 0.0010
Endrin	LT 0.0010
Endrin Kelone	0.0048 BJP
gamma-Chlordane	0.0033 JP
Heptachlor	0.0032 JPG+
Heptachlor Epoxide	0.0041 JP
Lindane	0.0076 JPG+
Methoxychlor	0.0014 JP

HERBICIDES	
Laboratory Id Number	Units
Dichlorprop	LT 0.0100
Dinoseb	LT 0.0100

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
CREK	SRSD01	NSDP3*13	0.0	10-SEP-96	ES	NSDP3*13	SNV1/S					
							78-59-1	Isophorone	LT .14	UGG		
							83-32-9	Acenaphthene	LT .14	UGG		
							84-66-2	Diethyl phthalate	LT .14	UGG		
							84-74-2	Di-n-butyl phthalate	LT .14	UGG		
							85-01-8	Phenanthrene	LT .14	UGG		
							85-68-7	Butylbenzyl phthalate	LT .14	UGG		
							86-30-6	N-Nitrosodiphenylamine	LT .14	UGG		
							86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG		
							86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG		
							87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG		
							87-86-5	Pentachlorophenol	LT .67	UGG		
							88-06-2	2,4,6-Trichlorophenol	LT .3	UGG		
							88-74-4	2-Nitroaniline	LT .67	UGG		
							88-75-5	2-Nitrophenol	LT .14	UGG		
							91-20-3	Naphthalene / Tar camphor	LT .14	UGG		
							91-57-6	2-Methylnaphthalene	LT .14	UGG		
							91-58-7	2-Chloronaphthalene	LT .14	UGG		
							91-94-1	3,3'-Dichlorobenzidine	LT .67	UGG		
							95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG		
							95-50-1	1,2-Dichlorobenzene	LT .14	UGG		
							95-57-8	2-Chlorophenol	LT .14	UGG		
							95-95-4	2,4,5-Trichlorophenol	LT .3	UGG		
							98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG		
							99-09-2	3-Nitroaniline	LT .67	UGG	S	
								2,6-Dimethylundecane	.39	UGG		
								4-Bromophenyl phenyl ether	LT .14	UGG		
								4-Chlorophenyl phenyl ether	LT .14	UGG		
								Unknown compound 569	.4	UGG	S	
								Unknown compound 576	.5	UGG	S	
								Unknown compound 601	.5	UGG	S	
								Unknown compound 603	.4	UGG	S	
								Unknown compound 613	.4	UGG	S	
								Unknown compound 619	.4	UGG	S	
								Unknown compound 635	1	UGG	S	
LAKE	SD-LMBAR-1	SAIC01	0.0	16-MAY-97	ES	SNSA*697	HBG1/S	2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG		?
								Dichloroprop				
							1918-00-9	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG		?
							7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPFP / *	LT .2	UGG		?

75-99-0

\* - Analyte Description has been truncated. See Data Dictionary

- 134 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMBAR-1	SAIC01	0.0	16-MAY-97	ES	SNSA*697	HBG1/S	75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichloro-	LT 1.00 E -2	UGG	?	
								88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	1.44 E -2	UGG C	?	
								93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
								93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG	?	
								94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolylo*	LT .2	UGG	?	
								94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG	?	
								94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG	?	
					UB	97U01641	EXL4/S	118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .1	UGG		
								121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
								2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
								479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
								88-72-2	2-Nitrotoluene	LT .4	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
								99-08-1	3-Nitrotoluene	LT .4	UGG		
								99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
								99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
								99-99-0	4-Nitrotoluene	LT .4	UGG		
									2-Amino-4,6-dinitrotoluene	LT .2	UGG		
									4-Amino-2,6-dinitrotoluene	LT .2	UGG		
									Arsenic	2.42	UGG		
									Lead	5.91	UGG		
									Antimony	LT .305	UGG		

GSE2/S 7782-49-2 Selenium  
 GTL2/S 7440-28-0 Thallium  
 HGCL/S 7439-97-6 Mercury  
 ICP3/S 7429-90-5 Aluminum  
 7439-89-6 Iron  
 7439-95-4 Magnesium  
 7439-96-5 Manganese  
 7439-98-7 Molybdenum  
 7440-02-0 Nickel

LT .25 UGG  
 LT .2 UGG  
 LT .1 UGG  
 2180 UGG  
 6470 UGG  
 20000 UGG  
 178 UGG  
 .914 UGG JP  
 4.7 UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 135 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag	Data Meas Codes	EPA Data Quals
LAKE	SD-LMBAR-1	SAIC01	0.0	16-MAY-97	UB	97U01641	ICP3/S	7440-09-7	Potassium	459	UGG		
								7440-22-4	Silver	LT .5	UGG	J	
								7440-23-5	Sodium	353	UGG		
								7440-31-5	Tin	LT 5	UGG	J	
								7440-39-3	Barium	8.12	UGG JP		
								7440-41-7	Beryllium	.126	UGG JP		
								7440-42-8	Boron	6.47	UGG		
								7440-43-9	Cadmium	LT .5	UGG		
								7440-47-3	Chromium	5.28	UGG		
								7440-48-4	Cobalt	2.41	UGG		
								7440-50-8	Copper	3.64	UGG		
								7440-62-2	Vanadium	18.8	UGG		
								7440-66-6	Zinc	60.6	UGG		
								7440-70-2	Calcium	41800	UGG		
								1024-57-3	Heptachlor epoxide	2.86 E -4	UGG JP		
								1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG		
								1104-28-2	PCB 1221	LT 1.30 E -2	UGG		
								11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
								309-00-2	Aldrin	5.04 E -4	UGG JP		
								319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	LT 1.00 E -3	UGG		
								319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	4.69 E -4	UGG BJP		

319-86-8 delta-Hexachlorocyclohexane / delta-Benzene hexachloride UGG BJP  
 33213-65-9 Endosulfan II / beta-Endosulfan LT 1.00 E -3 UGG  
 50-29-3 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane 1.45 E -3 UGG C  
 5103-71-9 alpha-Chlordane 3.33 E -4 UGG JP I  
 53469-21-9 PCB 1242 LT 1.30 E -2 UGG  
 53494-70-5 Endrin ketone LT 1.00 E -3 UGG  
 5566-34-7 gamma-Chlordane 2.90 E -4 UGG JP  
 58-89-9 Lindane / gamma-Benzene hexachloride 7.14 E -4 UGG JP  
 / gamma-Hexachlorocyc\*  
 60-57-1 Dieldrin 3.28 E -4 UGG JP  
 72-20-8 Endrin 3.74 E -4 UGG BJP  
 72-43-5 Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethylidene)\*  
 72-54-8 ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth\* 4.77 E -3 UGG C

\* - Analyte Description has been truncated. See Data Dictionary

- 136 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SW)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-LMBAR-1	SAIC01	0.0	16-MAY-97	UB	97U01641	PST2/S	72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	1.43 E -3	UGG	C		
								7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG			
								76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7a-tetra*	2.94 E -4	UGG	JP		
								8001-35-2	Toxaphene / Chlorinated camphene / Camphchlor / Alltox / *	LT .1	UGG			
								959-98-8	Endosulfan I / alpha-Endosulfan.	LT 1.00 E -3	UGG			
							SNV3/S	100-01-6	4-Nitroaniline	LT .14	UGG			
								100-02-7	4-Nitrophenol	LT .14	UGG			
								100-51-6	Benzyl alcohol	LT .14	UGG			
								105-67-9	2,4-Dimethylphenol	LT .14	UGG			
								106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG			
								106-46-7	1,4-Dichlorobenzene	LT .14	UGG			
								106-47-8	4-Chloroaniline	LT .14	UGG			
								108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG			
								108-95-2	Phenol / Carbolic acid / Phenic acid / Phenylc acid / Phe*	LT .14	UGG			
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG			

111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG
117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG
117-84-0	Di-n-octyl phthalate	LT .14	UGG
118-74-1	Hexachlorobenzene	LT .14	UGG
120-12-7	Anthracene	LT .14	UGG
120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG
120-83-2	2,4-Dichlorophenol	LT .14	UGG
121-14-2	2,4-Dinitrotoluene	LT .14	UGG
129-00-0	Benzo[def]phenanthrene / Pyrene	4.2 E -2	UGG JP
131-11-3	Dimethyl phthalate	LT .14	UGG
132-64-9	Dibenzofuran	LT .14	UGG
191-24-2	Benzo[ghi]perylene	LT .14	UGG
193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG
205-99-2	Benzo[b]fluoranthene / 3,4-Benzo[fluoranthene	LT .14	UGG
206-44-0	Fluoranthene	9.9 E -3	UGG JP
207-08-9	Benzo[k]fluoranthene	LT .14	UGG
208-96-8	Acenaphthylene	LT .14	UGG
218-01-9	Chrysene	LT .14	UGG
50-32-8	Benzo[a]pyrene	LT .14	UGG
51-28-5	2,4-Dinitrophenol	LT .14	UGG
53-70-3	Dibenz[ah]anthracene / 1,2,5,6-Dibenzanthracene	LT .14	UGG
534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 137 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag	Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMBAR-1	SAIC01	0.0	16-MAY-97	UB	97U01641		SNV3/S	541-73-1	1,3-Dichlorobenzene	LT .14	UGG			
									56-55-3	Benzo[a]anthracene	LT .14	UGG			
									59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG			
									606-20-2	2,6-Dinitrotoluene	LT .14	UGG			
									621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG			
									65-85-0	Benzoic acid	2.2 E -2	UGG JP			
									67-72-1	Hexachloroethane	LT .14	UGG			
									77-47-4	Hexachlorocyclopentadiene	LT .14	UGG			
									78-59-1	Isophorone	LT .14	UGG			
									83-32-9	Acenaphthene	LT .14	UGG			

84-66-2	Diethyl phthalate	LT .14	UGG
84-74-2	Di-n-butyl phthalate	LT .14	UGG
85-01-8	Phenanthrene	LT .14	UGG
85-68-7	Butylbenzyl phthalate	LT .14	UGG
86-30-6	N-Nitrosodiphenylamine	LT .14	UGG
86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG
86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG
87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG
87-86-5	Pentachlorophenol	LT .14	UGG
88-06-2	2,4,6-Trichlorophenol	LT .14	UGG
88-74-4	2-Nitroaniline	LT .14	UGG
88-75-5	2-Nitrophenol	LT .14	UGG
91-20-3	Naphthalene / Tar camphor	LT .14	UGG
91-57-6	2-Methylnaphthalene	LT .14	UGG
91-58-7	2-Chloronaphthalene	LT .14	UGG
91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG
95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG
95-50-1	1,2-Dichlorobenzene	LT .14	UGG
95-57-8	2-Chlorophenol	LT .14	UGG
95-95-4	2,4,5-Trichlorophenol	LT .14	UGG
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG
99-09-2	3-Nitroaniline	LT .14	UGG
	4-Bromophenyl phenyl ether	LT .14	UGG
VMS4/S 100-41-4	4-Chlorophenyl phenyl ether	LT .14	UGG
100-42-5	Ethylbenzene	LT 1.0 E -2	UGG
	Styrene / Ethenylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG
10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG
107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG
108-05-4			

- 138 -

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAVE	SD-LMBAR-1	SAIC01	0.0	16-MAY-97	UB	97U01641	VMS4/S	108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG		
								108-10-1	Methyl isobutyl ketone /	LT 1.0 E -2	UGG		

108-88-3	Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG
108-90-7	Toluene	LT 1.0 E -2	UGG
110-75-8	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG
	2-Chloroethyl vinyl ether / (2-		
	Chloroethoxy)ethene		
124-48-1	Dibromochloromethane /	LT 1.0 E -2	UGG
	Chlorodibromomethane		
127-18-4	Tetrachloroethylene /	LT 1.0 E -2	UGG
	Tetrachloroethene / Perchloroethylen*		
156-59-2	cis-1,2-Dichloroethylene / cis-1,2-	LT 1.0 E -2	UGG
	Dichloroethene		
156-60-5	trans-1,2-Dichloroethylene / trans-	LT 1.0 E -2	UGG
	1,2-Dichloroethene		
56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG
591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG
67-63-0	2-Propanol	8.3 E -3	UGG N
67-64-1	Acetone	.9	UGG B
67-66-3	Chloroform	LT 1.0 E -2	UGG
71-43-2	Benzene	LT 1.0 E -2	UGG
71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG
74-83-9	Bromomethane	LT 1.0 E -2	UGG
74-87-3	Chloromethane	LT 1.0 E -2	UGG
75-00-3	Chloroethane	LT 1.0 E -2	UGG
75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG
75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG
75-15-0	Carbon disulfide	LT 1.0 E -2	UGG
75-25-2	Bromoform	LT 1.0 E -2	UGG
75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG
75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG
75-35-4	1,1-Dichloroethylene / 1,1-	LT 1.0 E -2	UGG
	Dichloroethene		
75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG
75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG
78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG
78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG
79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG
79-01-6	Trichloroethylene / Trichloroethene /	LT 1.0 E -2	UGG
	Ethynyl trichloride / T*		
79-34-5	Tetrachloroethane / 1,1,2,2-	LT 1.0 E -2	UGG
	Tetrachloroethane / Acetylene *		
	Xylenes, total combined	LT 1.0 E -2	UGG

\* - Analyte Description has been truncated. See Data Dictionary



Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMBAR-1	SAIC01	0.0	16-MAY-97	UB 97U01641	VMS4/S	120-36-5	trans-1,3-Dichloropropene	LT 1.0 E -2	UGG		
	SD-LMHUT-1	SAIC01	0.0	16-MAY-97	ES SNSA*696	HBG1/S		2-(12,4-Dichlorophenoxy)propionic acid Dichloroprop	LT 1.00 E -2	UGG	?	
							1918-00-9	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG	?	
							7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP / *	LT .2	UGG	?	
							75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichloro*	LT 1.00 E -2	UGG	?	
							88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	1.79 E -2	UGG C	?	
							93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
							93-76-5	245T / 12,4,5-Trichlorophenoxy/ acetic acid / Trioxone / We*	LT 1.00 E -2	UGG	?	
							94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolyl)*	LT .2	UGG	?	
							94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG	?	
							94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG	?	
	UB	97U01642	EXL4/S				118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG		
							121-14-2	2,4-Dinitrotoluene	LT .1	UGG		
							121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
							2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
							479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
							606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
							88-72-2	2-Nitrotoluene	LT .4	UGG		
							98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
							99-08-1	3-Nitrotoluene	LT .4	UGG		
							99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
							99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
							99-99-0	4-Nitrotoluene	LT .4	UGG		
								2-Amino-4,6-dinitrotoluene	LT .2	UGG		
								4-Amino-2,6-dinitrotoluene	LT .2	UGG		
								Arsenic	2.6	UGG		
							7440-38-2	Lead	6.83	UGG		
							7439-92-1	Antimony	LT .305	UGG		
							7440-36-0	Selenium	LT .25	UGG		
							7782-49-2					

\* - Analyte Description has been truncated. See Data Dictionary

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals	
LAKE	SD-LMHUT-1	SAIC01	0.0	16-MAY-97	UB	97U01642	GTL2/S HGCL/S ICP3/S	7440-28-0	Thallium	LT .2	UGG		
								7439-97-6	Mercury	LT .1	UGG		
								7429-90-5	Aluminum	2270	UGG		
								7439-89-6	Iron	7350	UGG		
								7439-95-4	Magnesium	14800	UGG		
								7439-96-5	Manganese	164	UGG		
								7439-98-7	Molybdenum	2.36	UGG	J	
								7440-02-0	Nickel	4.56	UGG		
								7440-09-7	Potassium	496	UGG		
								7440-22-4	Silver	LT .5	UGG	J	
								7440-23-5	Sodium	312	UGG		
								7440-31-5	Tin	LT 5	UGG	J	
								7440-39-3	Barium	8.28	UGG	JP	
								7440-41-7	Beryllium	.121	UGG	JP	
								7440-42-8	Boron	7.84	UGG		
								7440-43-9	Cadmium	LT .5	UGG		
								7440-47-3	Chromium	6.09	UGG		
								7440-48-4	Cobalt	2.6	UGG		
								7440-50-8	Copper	4.15	UGG		
								7440-62-2	Vanadium	20.5	UGG		
								7440-66-6	Zinc	22.6	UGG		
								7440-70-2	Calcium	30500	UGG		
								EST2/S	1024-57-3	Heptachlor epoxide	4.44 E -4	UGG	JP
									1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG	
									1104-28-2	PCB 1221	LT 1.30 E -2	UGG	
									11096-82-5	PCB 1260	LT 1.30 E -2	UGG	
									11097-69-1	PCB 1254	LT 1.30 E -2	UGG	
									11141-16-5	PCB 1232	LT 1.30 E -2	UGG	
									12672-29-6	PCB 1248	LT 1.30 E -2	UGG	
									12674-11-2	PCB 1016	LT 1.30 E -2	UGG	
									309-00-2	Aldrin	6.22 E -4	UGG	JP
									319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride			8.25 E -4
beta-Hexachlorocyclohexane / beta-Benzene hexachloride			4.73 E -4	UGG	BJP								
delta-Hexachlorocyclohexane / delta-Benzene hexachloride			1.32 E -3	UGG	BU								
Endosulfan II / beta-Endosulfan			LT 1.00 E -3	UGG									
33213-65-9	2,2-Bis(p-chlorophenyl)-1,1,1-			8.48 E -3	UGG	C							

trichloroethane  
 5103-71-9 alpha-Chlordane  
 53469-21-9 PCB 1242  
 53494-70-5 Endrin ketone  
 5566-34-7 gamma-Chlordane

4.78 E -4  
 LT 1.30 E -2  
 3.54 E -4  
 5.37 E -4  
 UGG JP  
 UGG  
 UGG JP  
 UGG JP

\* - Analyte Description has been truncated. See Data Dictionary

- 141 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-14MHUT-1	SAIC01	0.0	16-MAY-97	UB	97U01642	PST2/S	58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc*	7.52 E -4	UGG JP		
								60-57-1	Dieldrin	4.39 E -4	UGG JP		
								72-20-8	Endrin	5.02 E -4	UGG BJP		
								72-43-5	Methoxychlor / Methoxy-DDT / 1,1'- ppDDD / 1,1-Dichloro-2,2-bis(p- chlorophenyl)ethane / Rhoth*	1.63 E -3	UGG JP		
								72-54-8	(2,2,2-Trichloroethylide*	1.08 E -2	UGG C		
								72-55-9	2,2-Bis(p-chlorophenyl)-1,1- dichloroethene	4.13 E -3	UGG C		
								7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG		
								76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8- Heptachloro-3a,4,7,7a-tetra*	7.30 E -4	UGG JP		
								8001-35-2	Toxaphene / Chlorinated camphene / Camphchlor / Alltox / *	LT .1	UGG		
								959-98-8	Endosulfan I / alpha-Endosulfan	3.35 E -4	UGG JP		
							SMW3/S	100-01-6	4-Nitroaniline	LT .14	UGG		
								100-02-7	4-Nitrophenol	LT .14	UGG		
								100-51-6	Benzyl alcohol	LT .14	UGG		
								105-67-9	2,4-Dimethylphenol	LT .14	UGG		
								106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG		
								106-46-7	1,4-Dichlorobenzene	LT .14	UGG		
								106-47-8	4-Chloroaniline	LT .14	UGG		
								108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG		
								108-95-2	Phenol / Carboic acid / Phenic acid / Phenylic acid / Phe*	LT .14	UGG		
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG		
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG		
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG		
								117-84-0	Di-n-octyl phthalate	LT .14	UGG		
								118-74-1	Hexachlorobenzene	LT .14	UGG		

120-12-7	Anthracene	LT .14	UGG
120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG
120-83-2	2,4-Dichlorophenol	LT .14	UGG
121-14-2	2,4-Dinitrotoluene	LT .14	UGG
129-00-0	Benzo[def]phenanthrene / Pyrene	3.1 E -2	UGG JP
131-11-3	Dimethyl phthalate	LT .14	UGG
132-64-9	Dibenzofuran	LT .14	UGG
191-24-2	Benzo[ghi]perylene	LT .14	UGG
193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG
205-99-2	Benzo[b]fluoranthene / 3,4-	LT .14	UGG
	Benzo[fluoranthene		
206-44-0	Fluoranthene	2.2 E -2	UGG JP
207-08-9	Benzo[k]fluoranthene	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 142 -

30-JAN-98

16:17:59

# Final Documentation Appendix Report

Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Lab Matrix	Meth/ CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMHUT-1	SAIC01	0.0	16-MAY-97	UB	97U01642	SMV3/S	208-96-8	Acenaphthylene	LT .14	UGG		
								218-01-9	Chrysene	LT .14	UGG		
								50-32-8	Benzo[a]pyrene	LT .14	UGG		
								51-28-5	2,4-Dinitrophenol	LT .14	UGG		
								53-70-3	Dibenz[ah]anthracene / 1,2:5,6-	LT .14	UGG		
								534-52-1	Dibenzanthracene				
									4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG		
								541-73-1	1,3-Dichlorobenzene	LT .14	UGG		
								56-55-3	Benzo[a]anthracene	LT .14	UGG		
								59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .14	UGG		
								621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG		
								65-85-0	Benzoic acid	3.6 E -2	UGG JP		
								67-72-1	Hexachloroethane	LT .14	UGG		
								77-47-4	Hexachlorocyclopentadiene	LT .14	UGG		
								78-59-1	Isophorone	LT .14	UGG		
								83-32-9	Acenaphthene	LT .14	UGG		
								84-66-2	Diethyl phthalate	LT .14	UGG		
								84-74-2	Di-n-butyl phthalate	LT .14	UGG		
								85-01-8	Phenanthrene	.11	UGG JP		
								85-68-7	Butylbenzyl phthalate	2.2 E -2	UGG JP		
										LT .14	UGG		

86-30-6	N-Nitrosodiphenylamine	LT .14	UGG
86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG
86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG
87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG
87-86-5	Pentachlorophenol	LT .14	UGG
88-06-2	2,4,6-Trichlorophenol	LT .14	UGG
88-74-4	2-Nitroaniline	LT .14	UGG
88-75-5	2-Nitrophenol	LT .14	UGG
91-20-3	Naphthalene / Tar camphor	LT .14	UGG
91-57-6	2-Methylnaphthalene	LT .14	UGG
91-58-7	2-Chloronaphthalene	LT .14	UGG
91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG
95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG
95-50-1	1,2-Dichlorobenzene	LT .14	UGG
95-57-8	2-Chlorophenol	LT .14	UGG
95-95-4	2,4,5-Trichlorophenol	LT .14	UGG
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG
99-09-2	3-Nitroaniline	LT .14	UGG
	4-Bromophenyl phenyl ether	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 143 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMHUT-1	SAIC01	0.0	16-MAY-97	UB	97U01642	SMV3/S	100-41-4	4-Chlorophenyl phenyl ether	LT .14	UGG		
							VMS4/S	100-42-5	Ethylbenzene	LT 1.0 E -2	UGG		
								10061-01-5	Styrene / Ethenylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG		
								107-06-2	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG		
								108-05-4	1,2-Dichloroethane	LT 1.0 E -2	UGG		
								108-10-1	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG		
								108-88-3	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG		
								108-90-7	Toluene	LT 1.0 E -2	UGG		
								110-75-8	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG		
									2-Chloroethyl vinyl ether / (2-Chloroethoxy)ethene	LT 1.0 E -2	UGG		

124-48-1	Dibromochloromethane /	LT 1.0 E -2	UGG
	Chlorodibromomethane		
127-18-4	Tetrachloroethylene /	LT 1.0 E -2	UGG
	Tetrachloroethene / Perchloroethylen*		
156-59-2	cis-1,2-Dichloroethylene / cis-1,2-	LT 1.0 E -2	UGG
	Dichloroethene		
156-60-5	trans-1,2-Dichloroethylene / trans-	LT 1.0 E -2	UGG
	1,2-Dichloroethene		
56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG
591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG
67-64-1	Acetone	8.3 E -2	UGG
67-66-3	Chloroform	LT 1.0 E -2	UGG
71-43-2	Benzene	LT 1.0 E -2	UGG
71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG
74-83-9	Bromomethane	LT 1.0 E -2	UGG
74-87-3	Chloromethane	LT 1.0 E -2	UGG
75-00-3	Chloroethane	LT 1.0 E -2	UGG
75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG
75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG
75-15-0	Carbon disulfide	LT 1.0 E -2	UGG
75-25-2	Bromoform	LT 1.0 E -2	UGG
75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG
75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG
75-35-4	1,1-Dichloroethylene / 1,1-	LT 1.0 E -2	UGG
	Dichloroethene		
75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG
75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG
78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG
78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 144 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site	Site	Field	Sample	Lab	Lab	Matrix	CAS No.	Analyte Description	Me	Unit	Flag	Data	EPA Data
Type	ID	Sample No.	Date	Anly.	No.				Bo	Meas	Codes	Quals	Quals
LAKE	SD-LXHUT-1	SAIC01	0.0 16-MAY-97	UB	97U01642	WMS4/S	79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG			
							79-01-6	Trichloroethylene /Trichloroethene /	LT 1.0 E -2	UGG			
								Ethynyl trichloride /T*					
							79-34-5	Tetrachloroethane / 1,1,2,2-	LT 1.0 E -2	UGG			
								Tetrachloroethane / Acetylene *					
								Xylenes, total combined	LT 1.0 E -2	UGG			
								trans-1,3-Dichloropropene	LT 1.0 E -2	UGG			

SD-LMJAN-1	SAIC01	0.0	16-MAY-97	ES	SNSA*694	HBCI/S	120-36-5	2-(2,4-Dichlorophenoxy)propionic acid Dichloroprop	LT 1.00 E -2	UGG	?
							1918-00-9	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG	?
							7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP / *	LT .2	UGG	?
							75-99-0	Dalapon / alpha, alpha-Dichloropropionic acid / 2,2-Dichloro*	LT 1.00 E -2	UGG	?
							88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG	?
							93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?
							93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG	?
							94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolyl)*	LT .2	UGG	?
							94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG	?
							94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG	?
				UB	97U01643	EXL4/S	118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG	
							121-14-2	2,4-Dinitrotoluene	LT .1	UGG	
							121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG	
							2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG	
							479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG	
							606-20-2	2,6-Dinitrotoluene	LT .2	UGG	
							88-72-2	2-Nitrotoluene	LT .4	UGG	
							98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG	
							99-08-1	3-Nitrotoluene	LT .4	UGG	
							99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG	
							99-65-0	1,3-Dinitrobenzene	LT .1	UGG	
							99-99-0	4-Nitrotoluene	LT .4	UGG	

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo	Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
-----------	---------	------------------	-------	-------------	---------------	------------------	---------	---------------------	-------	------	-----------	------------	------------	----------------





30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation : Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-1M/JAN-1	SAIC01	0.0	16-MAY-97	UB	97U01643	PST2/S	50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	2.58 E -3	UGG C		
								5103-71-9	alpha-Chlordane	LT 1.00 E -3	UGG		I
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG		
								53494-70-5	Endrin ketone	LT 1.00 E -3	UGG		
								5566-34-7	gamma-Chlordane	5.34 E -4	UGG JP		
								58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc*	8.14 E -4	UGG JP		
								60-57-1	Dieldrin	5.20 E -4	UGG JP		
								72-20-8	Endrin	6.03 E -4	UGG BJP		
								72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethylidene)*	1.54 E -3	UGG JP		
								72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	3.26 E -3	UGG C		
								72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	1.65 E -3	UGG C		
								7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG		
								76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetra*	3.16 E -4	UGG JP		
								8001-35-2	Toxaphene / Chlorinated camphene / Camphchlor / Alltox / *	LT .1	UGG		
								959-98-8	Endosulfan I / alpha-Endosulfan	3.49 E -4	UGG JP		
							SMV3/S	100-01-6	4-Nitroaniline	LT .14	UGG		
								100-02-7	4-Nitrophenol	LT .14	UGG		
								100-51-6	Benzyl alcohol	LT .14	UGG		
								105-67-9	2,4-Dimethylphenol	LT .14	UGG		
								106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG		
								106-46-7	1,4-Dichlorobenzene	LT .14	UGG		
								106-47-8	4-Chloroaniline	LT .14	UGG		
								108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG		
								108-95-2	Phenol / Carbolic acid / Phenic acid / Phenylic acid / Phe*	LT .14	UGG		
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG		
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG		
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG		
								117-84-0	Di-n-octyl phthalate	LT .14	UGG		
								118-74-1	Hexachlorobenzene	LT .14	UGG		
								120-12-7	Anthracene	LT .14	UGG		
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
								120-83-2	2,4-Dichlorophenol	LT .14	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG		
								129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG		
								131-11-3	Dimethyl phthalate	LT .14	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

- 147 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Port Sheridan, IL (SW)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LAJAN-1	SAIC01	0.0	16-MAY-97	UB	97U01643	SMV3/S					
							191-24-2	Benzo[ghi]perylene	LT .14	UGG		
							193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG		
							205-99-2	Benzo[b]fluoranthene / 3,4- Benzo[fluoranthene	LT .14	UGG		
							206-44-0	Fluoranthene	LT .14	UGG		
							207-08-9	Benzo[k]fluoranthene	LT .14	UGG		
							208-96-8	Acenaphthylene	LT .14	UGG		
							218-01-9	Chrysene	LT .14	UGG		
							50-32-8	Benzo[a]pyrene	LT .14	UGG		
							51-28-5	2,4-Dinitrophenol	LT .14	UGG		
							53-70-3	Dibenz[ah]anthracene / 1,2:5,6- Dibenzanthracene	LT .14	UGG		
							534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6- dinitrophenol	LT .14	UGG		
							541-73-1	1,3-Dichlorobenzene	LT .14	UGG		
							56-55-3	Benzo[a]anthracene	LT .14	UGG		
							59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3- cresol / 4-Chloro-3-m*	LT .14	UGG		
							606-20-2	2,6-Dinitrotoluene	LT .14	UGG		
							621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG		
							65-85-0	Benzoic acid	LT .14	UGG		
							67-72-1	Hexachloroethane	LT .14	UGG		
							77-47-4	Hexachlorocyclopentadiene	LT .14	UGG		
							78-59-1	Isophorone	LT .14	UGG		
							83-32-9	Acenaphthene	LT .14	UGG		
							84-66-2	Diethyl phthalate	LT .14	UGG		
							84-74-2	Di-n-butyl phthalate	LT .14	UGG		
							85-01-8	Phenanthrene	LT .14	UGG		
							85-68-7	Butylbenzyl phthalate	LT .14	UGG		
							86-30-6	N-Nitrosodiphenylamine	LT .14	UGG		
							86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG		
							86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG		
							87-68-3	Hexachlorobutadiene / Hexachloro-1,3- butadiene	LT .14	UGG		
							87-86-5	Pentachlorophenol	LT .14	UGG		

JP

E-2

88-06-2	2,4,6-Trichlorophenol	LT .14	UGG
88-74-4	2-Nitroaniline	LT .14	UGG
88-75-5	2-Nitrophenol	LT .14	UGG
91-20-3	Naphthalene / Tar camphor	LT .14	UGG
91-57-6	2-Methylnaphthalene	LT .14	UGG
91-58-7	2-Chloronaphthalene	LT .14	UGG
91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG
95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG
95-50-1	1,2-Dichlorobenzene	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 148 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SW)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LWJAN-1	SAIC01	0.0	16-MAY-97	UB	97U01643	SWV3/S	95-57-8	2-Chlorophenol	LT .14	UGG		
								95-95-4	2,4,5-Trichlorophenol	LT .14	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG		
								99-09-2	3-Nitroaniline	LT .14	UGG		
									4-Bromophenyl phenyl ether	LT .14	UGG		
									4-Chlorophenyl phenyl ether	LT .14	UGG		
							VMS4/S	100-41-4	Ethylbenzene	LT 1.0 E -2	UGG		
								100-42-5	Styrene / Ethylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG		
								10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG		
								107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG		
								108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG		
								108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG		
								108-88-3	Toluene	LT 1.0 E -2	UGG		
								108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG		
								110-75-8	2-Chloroethyl vinyl ether / (2-Chloroethoxy)ethene	LT 1.0 E -2	UGG		
								124-48-1	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG		
								127-18-4	Tetrachloroethylene / Perchloroethylen*	LT 1.0 E -2	UGG		
								156-59-2	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG		

156-60-5 trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene UGG LT 1.0 E -2

56-23-5 Carbon tetrachloride UGG LT 1.0 E -2

591-78-6 Methyl n-butyl ketone / 2-Hexanone UGG LT 1.0 E -2

67-64-1 Acetone UGG .9

67-66-3 Chloroform UGG LT 1.0 E -2

71-43-2 Benzene UGG LT 1.0 E -2

71-55-6 1,1,1-Trichloroethane UGG LT 1.0 E -2

74-83-9 Bromomethane UGG LT 1.0 E -2

74-87-3 Chloromethane UGG LT 1.0 E -2

75-00-3 Chloroethane UGG LT 1.0 E -2

75-01-4 Vinyl chloride / Chloroethene UGG LT 1.0 E -2

75-09-2 Methylene chloride / Dichloromethane UGG LT 1.0 E -2

75-15-0 Carbon disulfide UGG LT 1.0 E -2

75-25-2 Bromoform UGG LT 1.0 E -2

75-27-4 Bromodichloromethane UGG LT 1.0 E -2

75-34-3 1,1-Dichloroethane UGG LT 1.0 E -2

\* - Analyte Description has been truncated. See Data Dictionary

- 149 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-LMJAN-1	SAIC01	0.0	16-MAY-97	UB	97U01643	VMS4/S	75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG			
								75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG			
								75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG			
								78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG			
								78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG			
								79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG			
								79-01-6	Trichloroethylene / Trichloroethene / Ethinyl trichloride / T*	LT 1.0 E -2	UGG			
								79-34-5	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG			
									Xylenes, total combined	LT 1.0 E -2	UGG			
									trans-1,3-Dichloropropene	LT 1.0 E -2	UGG			
									2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG			
									Dichloroprop					
									Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG			
									(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP /	LT .2	UGG			

SD-LMLF7-1

SAIC01

0.0 16-MAY-97

ES

SNSR\*698

HBG1/S

120-36-5

1918-00-9

7085-19-0

- 150 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo	Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-1	SAIC01	0.0	16-MAY-97	UB	97U01644	EXL4/S	98-95-3	Nitrobenzene / Essence of mirbane	LT	.2	UGG		
									Oil of mirbane					
								99-08-1	3-Nitrotoluene	LT	.4	UGG		
								99-35-4	1,3,5-Trinitrobenzene	LT	.1	UGG		
								99-65-0	1,3-Dinitrobenzene	LT	.1	UGG		
								99-99-0	4-Nitrotoluene	LT	.4	UGG		
									2-Amino-4,6-dinitrotoluene	LT	.2	UGG		
									4-Amino-2,6dinitrotoluene	LT	.2	UGG		
									Arsenic		2.09	UGG		
									Lead		5.12	UGG		
									Antimony	LT	.305	UGG		

GSZ2/S	7782-49-2	Selenium	LT .25	UGG	
GTL2/S	7440-28-0	Thallium	LT .2	UGG	
HGCL/S	7439-97-6	Mercury	LT .1	UGG	
ICP3/S	7429-90-5	Aluminum	1450	UGG	
	7439-89-6	Iron	5280	UGG	
	7439-95-4	Magnesium	15000	UGG	
	7439-96-5	Manganese	157	UGG	
	7439-98-7	Molybdenum	1.11	UGG	
	7440-02-0	Nickel	4.4	UGG	
	7440-09-7	Potassium	301	UGG	
	7440-22-4	Silver	LT .5	UGG	
	7440-23-5	Sodium	161	UGG	
	7440-31-5	Tin	4.65	UGG	
	7440-39-3	Barium	4.84	UGG	
	7440-41-7	Beryllium	.101	UGG	
	7440-42-8	Boron	9.81	UGG	
	7440-43-9	Cadmium	.533	UGG	
	7440-47-3	Chromium	4.89	UGG	
	7440-48-4	Cobalt	1.85	UGG	
	7440-50-8	Copper	4.08	UGG	
	7440-62-2	Vanadium	13.5	UGG	
	7440-66-6	Zinc	20.8	UGG	
	7440-70-2	Calcium	30600	UGG	
PST2/S	1024-57-3	Heptachlor epoxide	3.41 E -4	UGG	
	1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG	
	1104-28-2	PCB 1221	LT 1.30 E -2	UGG	
	11096-82-5	PCB 1260	LT 1.30 E -2	UGG	
	11097-69-1	PCB 1254	LT 1.30 E -2	UGG	
	11141-16-5	PCB 1232	LT 1.30 E -2	UGG	
	12672-29-6	PCB 1248	LT 1.30 E -2	UGG	
	12674-11-2	PCB 1016	LT 1.30 E -2	UGG	
	309-00-2	Aldrin	5.21 E -4	UGG	
	319-84-6				

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-1	SAIC01	0.0	16-MAY-97	UB 97U01644			319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	8.22 E -4	UGG	BJP		
								319-85-7	beta-Hexachlorocyclohexane / beta-	LT 1.00 E -3	UGG			

319-86-8	Benzene hexachloride		1.01 E -3	UGG BJP
	delta-Hexachlorocyclohexane / delta-			
	Benzene hexachloride			
33213-65-9	Endosulfan II / beta-Endosulfan	LT 1.00 E -3	UGG	
50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	1.64 E -3	UGG C	
5103-71-9	alpha-Chlordane	3.91 E -4	UGG JP	I
53469-21-9	PCB 1242	LT 1.30 E -2	UGG	
53494-70-5	Endrin ketone	LT 1.00 E -3	UGG	
5566-34-7	gamma-Chlordane	3.61 E -4	UGG JP	
58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc*	LT 1.00 E -3	UGG	
60-57-1	Dieldrin	3.59 E -4	UGG JP	
72-20-8	Endrin	4.67 E -4	UGG BJP	
72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethylidene)*	1.34 E -3	UGG JP	
72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	3.01 E -3	UGG C	
72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	1.12 E -3	UGG JP	
7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG	
76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetra*	3.59 E -4	UGG JP	
8001-35-2	Toxaphene / Chlorinated camphene / Camphchlor / Alltox / *	LT .1	UGG	
959-98-8	Endosulfan I / alpha-Endosulfan	4.48 E -4	UGG JP	
100-01-6	4-Nitroaniline	LT .14	UGG	
100-02-7	4-Nitrophenol	LT .14	UGG	
100-51-6	Benzyl alcohol	LT .14	UGG	
105-67-9	2,4-Dimethylphenol	LT .14	UGG	
106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG	
106-46-7	1,4-Dichlorobenzene	LT .14	UGG	
106-47-8	4-Chloroaniline	LT .14	UGG	
108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG	
108-95-2	Phenol / Carboic acid / Phenic acid / Phenyllic acid / Phe*	LT .14	UGG	
111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG	
111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG	
117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG	
117-84-0	Di-n-octyl phthalate	LT .14	UGG	
118-74-1	Hexachlorobenzene	LT .14	UGG	

\* - Analyte Description has been truncated. See Data Dictionary

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-1	SAIC01	0.0	16-MAY-97	UB	97U01644	SMV3/S	120-12-7	Anthracene	LT .14	UGG		
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
								120-83-2	2,4-Dichlorophenol	LT .14	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG		
								129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG		
								131-11-3	Dimethyl phthalate	LT .14	UGG		
								132-64-9	Dibenzofuran	LT .14	UGG		
								191-24-2	Benzo[ghi]perylene	LT .14	UGG		
								193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG		
								205-99-2	Benzo[b]fluoranthene / 3,4-Benzofluoranthene	LT .14	UGG		
								206-44-0	Fluoranthene	LT .14	UGG		
								207-08-9	Benzo[k]fluoranthene	LT .14	UGG		
								208-96-8	Acenaphthylene	LT .14	UGG		
								218-01-9	Chrysene	LT .14	UGG		
								50-32-8	Benzo[a]pyrene	LT .14	UGG		
								51-28-5	2,4-Dinitrophenol	LT .14	UGG		
								53-70-3	Dibenz[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG		
								534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG		
								541-73-1	1,3-Dichlorobenzene	LT .14	UGG		
								56-55-3	Benzo[a]anthracene	LT .14	UGG		
								59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .14	UGG		
								621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG		
								65-85-0	Benzoic acid	2.2 E -2	UGG JP		
								67-72-1	Hexachloroethane	LT .14	UGG		
								77-47-4	Hexachlorocyclopentadiene	LT .14	UGG		
								78-59-1	Isophorone	LT .14	UGG		
								83-32-9	Acenaphthene	LT .14	UGG		
								84-66-2	Diethyl phthalate	LT .14	UGG		
								84-74-2	Di-n-butyl phthalate	LT .14	UGG		
								85-01-8	Phenanthrene	LT .14	UGG		
								85-68-7	Butylbenzyl phthalate	LT .14	UGG		
								86-30-6	N-Nitrosodiphenylamine	LT .14	UGG		
								86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG		
								86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG		
								87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG		
								87-86-5	Pentachlorophenol	LT .14	UGG		
								88-06-2	2,4,6-Trichlorophenol	LT .14	UGG		
								88-74-4	2-Nitroaniline	LT .14	UGG		

\* - Analyte Description has been truncated. See Data Dictionary



30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-IMLF7-1	SAIC01	0.0	16-MAY-97	UB	97U01644	SMV3/S	88-75-5	2-Nitrophenol	LT .14	UGG		
								91-20-3	Naphthalene / Tar camphor	LT .14	UGG		
								91-57-6	2-Methylnaphthalene	LT .14	UGG		
								91-58-7	2-Chloronaphthalene	LT .14	UGG		
								91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG		
								95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG		
								95-50-1	1,2-Dichlorobenzene	LT .14	UGG		
								95-57-8	2-Chlorophenol	LT .14	UGG		
								95-95-4	2,4,5-Trichlorophenol	LT .14	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG		
								99-09-2	3-Nitroaniline	LT .14	UGG		
									4-Bromophenyl phenyl ether	LT .14	UGG		
									4-Chlorophenyl phenyl ether	LT .14	UGG		
									Ethylbenzene	LT 1.0 E -2	UGG		
									Styrene / Ethenylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG		
									cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG		
									1,2-Dichloroethane	LT 1.0 E -2	UGG		
									Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG		
									Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG		
									Toluene	LT 1.0 E -2	UGG		
									Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG		
									2-Chloroethyl vinyl ether / (2-Chloroethoxy)ethene	LT 1.0 E -2	UGG		
									Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG		
									Tetrachloroethylene / Perchloroethylen*	LT 1.0 E -2	UGG		
									cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG		
									trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG		
									Carbon tetrachloride	LT 1.0 E -2	UGG		
									Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG		
									2-Propanol	2.4 E -2	UGG	N	

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

16:17:59

67-64-1 Acetone UGG B  
67-66-3 Chloroform UGG  
71-43-2 Benzene UGG  
71-55-6 1,1,1-Trichloroethane UGG  
74-83-9 Bromomethane UGG

- 154 -

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-1	SAIC01	0.0	16-MAY-97	UB	97U01644	WKS4/S	74-87-3	Chloromethane	LT 1.0 E -2	UGG		
								75-00-3	Chloroethane	LT 1.0 E -2	UGG		
								75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG		
								75-09-2	Methylene chloride / Dichloromethane	6.0 E -4	UGG JP		
								75-15-0	Carbon disulfide	LT 1.0 E -2	UGG		
								75-25-2	Bromoform	LT 1.0 E -2	UGG		
								75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG		
								75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG		
								75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG		
								75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG		
								75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG		
								78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG		
								78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG		
								79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG		
								79-01-6	Trichloroethylene / Trichloroethene / Ethinyl trichloride /T*	LT 1.0 E -2	UGG		
								79-34-5	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG		
									Xylenes, total combined	LT 1.0 E -2	UGG		
									trans-1,3-Dichloropropene	LT 1.0 E -2	UGG		
									2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG		
									Dichloroprop				
									Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG		
									(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP *	LT .2	UGG		
									Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichlor*	LT 1.00 E -2	UGG		
									Dinoseb / 2,4-Dinitro-6-sec-	LT 1.00 E -2	UGG		

SD-LMLF7-2 SAIC01 0.0 16-MAY-97 ES SNSA\*664 HBGI/S 120-36-5 1918-00-9 7085-19-0

\* - Analyte Description has been truncated. See Data Dictionary

- 155 -

30-JAN-93

16:17:59

Final Documentation Appendix Report

Installation : Fort Sheridan, IL (SH)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-2	SAIC01	0.0	16-MAY-97	UB	97U01645	EXL4/S	121-14-2	2,4-Dinitrotoluene	LT .1	UGG		
								121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
								2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
								479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
								88-72-2	2-Nitrotoluene	LT .4	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
								99-08-1	3-Nitrotoluene	LT .4	UGG		
								99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
								99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
								99-99-0	4-Nitrotoluene	LT .4	UGG		
									2-Amino-4,6-dinitrotoluene	LT .2	UGG		
									4-Amino-2,6-dinitrotoluene	LT .2	UGG		
									Arsenic	2.3	UGG		
									Lead	5.38	UGG		
									Antimony	LT .305	UGG		
									Selenium	LT .25	UGG		
									Thallium	LT .2	UGG		
									Mercury	LT .1	UGG		
									Aluminum	2250	UGG		

UB 97U01645 EXL4/S 118-96-7

93-72-1 butylphenol / 2-sec-Butyl-4,6-  
245TP / Silvex / 2-(2,4,5-  
Trichlorophenoxy)propionic acid \*  
93-76-5 245T / (2,4,5-Trichlorophenoxy)acetic  
acid / Trioxone / We\*  
94-74-6 (4-Chloro-2-methylphenoxy)acetic acid  
/ (4-Chloro-o-tolyl)  
94-75-7 2,4-D / 2,4-Dichlorophenoxyacetic  
acid  
94-82-6 2,4-DB / 4-(2,4-  
Dichlorophenoxy)butyric acid  
2,4,6-Trinitrotoluene / alpha-  
Trinitrotoluene

LT 1.00 E -2

UGG

LT 1.00 E -2

UGG

LT .2

UGG

LT 1.00 E -2

UGG

LT 1.00 E -2

UGG

LT .2

UGG

7439-89-6	Iron	5570	UGG	
7439-95-4	Magnesium	17500	UGG	
7439-96-5	Manganese	179	UGG	
7439-98-7	Molybdenum	1.61	UGG	J
7440-02-0	Nickel	4.5	UGG	
7440-09-7	Potassium	506	UGG	
7440-22-4	Silver	LT .5	UGG	J
7440-23-5	Sodium	314	UGG	
7440-31-5	Tin	6.35	UGG	
7440-39-3	Barium	7.72	UGG	JP
7440-41-7	Beryllium	.11	UGG	JP
7440-42-8	Boron	11.8	UGG	
7440-43-9	Cadmium	LT .5	UGG	
7440-47-3	Chromium	5.01	UGG	
7440-48-4	Cobalt	2.19	UGG	JP
7440-50-8	Copper	5.29	UGG	
7440-62-2	Vanadium	13.3	UGG	
7440-66-6	Zinc	41	UGG	
7440-70-2	Calcium	36600	UGG	
1024-57-3	Heptachlor epoxide	3.39 E -4	UGG	JP
1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG	

PST2/S

\* - Analyte Description has been truncated. See Data Dictionary

- 156 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-IMLF7-2	SAIC01	0.0	16-MAY-97	UB	97U01645	PST2/S	1104-28-2	PCB 1221	LT 1.30 E -2	UGG		
								11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
								309-00-2	Aldrin	5.28 E -4	UGG	JP	
								319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	8.36 E -4	UGG	BJP	
								319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	4.21 E -4	UGG	BJP	
								319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.07 E -3	UGG	BJP	
								33213-65-9	Endosulfan II / beta-Endosulfan	2.63 E -4	UGG	JP	
								50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-	1.68 E -3	UGG	C	



120-12-7	Anthracene	LT .14	UGG
120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG
120-83-2	2,4-Dichlorophenol	LT .14	UGG
121-14-2	2,4-Dinitrotoluene	LT .14	UGG
129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG
131-11-3	Dimethyl phthalate	LT .14	UGG
132-64-9	Dibenzofuran	LT .14	UGG
191-24-2	Benzo[ghi]perylene	LT .14	UGG
193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG
205-99-2	Benzo[b]fluoranthene / 3,4-Benzofluoranthene	LT .14	UGG
206-44-0	Fluoranthene	LT .14	UGG
207-08-9	Benzo[k]fluoranthene	LT .14	UGG
208-96-8	Acenaphthylene	LT .14	UGG
218-01-9	Chrysene	LT .14	UGG
50-32-8	Benzo[a]pyrene	LT .14	UGG
51-28-5	2,4-Dinitrophenol	LT .14	UGG
53-70-3	Dibenz[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG
534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG
541-73-1	1,3-Dichlorobenzene	LT .14	UGG
56-55-3	Benzo[a]anthracene	LT .14	UGG
59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG
606-20-2	2,6-Dinitrotoluene	LT .14	UGG
621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG
65-85-0	Benzoic acid	1.8 E -2	JP
67-72-1	Hexachloroethane	LT .14	UGG
77-47-4	Hexachlorocyclopentadiene	LT .14	UGG
78-59-1	Isophorone	LT .14	UGG
83-32-9	Acenaphthene	LT .14	UGG
84-66-2	Diethyl phthalate	LT .14	UGG
84-74-2	Di-n-butyl phthalate	LT .14	UGG
85-01-8	Phenanthrene	LT .14	UGG
85-68-7	Butylbenzyl phthalate	LT .14	UGG
86-30-6	N-Nitrosodiphenylamine	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 158 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
-----------	---------	------------------	-------	-------------	---------------	------------------	---------------------	------------	----------------------	------------	----------------



Final Documentation Appendix Report  
 Installation : Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-2	SAIC01	0.0	16-MAY-97	UB	97U01645	VMS4/S	591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG		
								67-64-1	Acetone	.12	UGG		
								67-66-3	Chloroform	LT 1.0 E -2	UGG		
								71-43-2	Benzene	LT 1.0 E -2	UGG		
								71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG		
								74-83-9	Bromomethane	LT 1.0 E -2	UGG		
								74-87-3	Chloromethane	LT 1.0 E -2	UGG		
								75-00-3	Chloroethane	LT 1.0 E -2	UGG		
								75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG		
								75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG		
								75-15-0	Carbon disulfide	LT 1.0 E -2	UGG		
								75-25-2	Bromoform	LT 1.0 E -2	UGG		
								75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG		
								75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG		
								75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG		
								75-43-4	Dichloroethene	LT 1.0 E -2	UGG		
								75-69-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG		
								78-87-5	Trichlorofluoromethane	LT 1.0 E -2	UGG		
								78-93-3	1,2-Dichloropropane	LT 1.0 E -2	UGG		
								79-00-5	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG		
								79-01-6	1,1,2-Trichloroethane	LT 1.0 E -2	UGG		
								79-34-5	Trichloroethylene / Trichloroethene / Ethinyl trichloride / T*	LT 1.0 E -2	UGG		
									Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG		
									Xylenes, total combined	LT 1.0 E -2	UGG		
									trans-1,3-Dichloropropene	LT 1.0 E -2	UGG		
SD-LMLF7-3	SAIC01		0.0	16-MAY-97	ES	SNSA*699	HBG1/S	120-36-5	2-(2,4-dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG	?	
									Dichloroprop		UGG	?	
								1918-00-9	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG	?	
								7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPp / *	LT .2	UGG	?	
								75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichloro*	LT 1.00 E -2	UGG	?	
								88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG	?	
								93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
								93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG	?	
								94-74-6	(4-Chloro-2-methylphenoxy)acetic acid	LT .2	UGG	?	



/ 14-Chloro-o-tolylo\*

\* - Analyte Description has been truncated. See Data Dictionary

- 160 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-3	SAIC01	0.0	16-MAY-97	ES	SNSA*699	HBG1/S	94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG	?	
								94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG	?	
					UP	97U01646	EXL4/S	118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .1	UGG		
								121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
								2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
								479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
								88-72-2	2-Nitrotoluene	LT .4	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
								99-08-1	3-Nitrotoluene	LT .4	UGG		
								99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
								99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
								99-99-0	4-Nitrotoluene	LT .4	UGG		
									2-Amino-4,6-dinitrotoluene	LT .2	UGG		
									4-Amino-2,6-dinitrotoluene	LT .2	UGG		
								7440-38-2	Arsenic	2.44	UGG		
								GPB1/S	Lead	7.73	UGG		
								GSB2/S	Antimony	LT .305	UGG		
								7782-49-2	Selenium	LT .25	UGG		
								7440-28-0	Thallium	LT .2	UGG		
								7439-97-6	Mercury	LT .1	UGG		
								7429-90-5	Aluminum	2730	UGG		
								7439-89-6	Iron	8230	UGG		
								7439-95-4	Magnesium	24600	UGG		
								7439-96-5	Manganese	204	UGG		
								7439-98-7	Molybdenum	LT 1	UGG		
								7440-02-0	Nickel	5.19	UGG		
								7440-09-7	Potassium	545	UGG		

J

7440-22-4	Silver	LT .5	UGG	J
7440-23-5	Sodium	435	UGG	
7440-31-5	Tin	LT 5	UGG	J
7440-39-3	Barium	8.82	UGG JP	
7440-41-7	Beryllium	.15	UGG JP	
7440-42-8	Boron	9.53	UGG	
7440-43-9	Cadmium	.489	UGG JP	
7440-47-3	Chromium	6.9	UGG	
7440-48-4	Cobalt	3.09	UGG	

\* - Analyte Description has been truncated. See Data Dictionary

- 161 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-3	SAIC01	0.0	16-MAY-97	UB	97U01646	ICP3/S	7440-50-8	Copper	4.93	UGG		
								7440-62-2	Vanadium	27.5	UGG		
								7440-66-6	Zinc	49.3	UGG		
								7440-70-2	Calcium	50500	UGG		
						PST2/S		1024-57-3	Heptachlor epoxide	3.56 E -4	UGG JP		
								1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG		
								1104-28-2	PCB 1221	LT 1.30 E -2	UGG		
								11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
								309-00-2	Aldrin	5.58 E -4	UGG JP		
								319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	8.87 E -4	UGG BJP		
								319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	6.34 E -4	UGG BJP		
								319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.19 E -3	UGG BJP		
								33213-65-9	Endosulfan II / beta-Endosulfan	2.88 E -4	UGG JP		
								50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	1.62 E -3	UGG C		
								5103-71-9	alpha-Chlordane	3.50 E -4	UGG JP		
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG		
								53494-70-5	Endrin ketone	LT 1.00 E -3	UGG		
								5566-34-7	gamma-Chlordane	3.97 E -4	UGG JP		
								58-89-9	Lindane / gamma-Benzene hexachloride	7.15 E -4	UGG JP		

60-57-1 / gamma-Hexachlorocyc\*  
 72-20-8 Dieldrin UGG JP 4.35 E -4  
 72-43-5 Endrin UGG BUP 5.74 E -4  
 72-54-8 Methoxychlor / Methoxy-DDT / 1,1'- UGG JP 1.68 E -3  
 72-55-9 (2,2,2-Trichloroethylidene\* UGG C 4.90 E -3  
 ppDDD / 1,1-Dichloro-2,2-bis(p- UGG JP 1.07 E -3  
 chlorophenyl)ethane / Rhoth\*  
 2,2-Bis(p-chlorophenyl)-1,1-  
 dichloroethene  
 7421-93-4 Endrin aldehyde LT 1.00 E -3  
 76-44-8 Heptachlor / 1H-1,4,5,6,7,8,8- UGG JP 3.12 E -4  
 Heptachloro-3a,4,7,7a-tetra\*  
 8001-35-2 Toxaphene / Chlorinated camphene / UGG  
 Camphechlor / Alltox / \*  
 959-98-8 Endosulfan I / alpha-Endosulfan UGG  
 100-01-6 4-Nitroaniline UGG  
 100-02-7 4-Nitrophenol UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 162 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation : Fort Sheridan, IL (SN)  
 File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-IMLF7-3	SAIC01	0.0	16-MAY-97	UB	97U01646	SNW3/S	100-51-6	Benzyl alcohol	LT .14	UGG			
								105-67-9	2,4-Dimethylphenol	LT .14	UGG			
								106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG			
								106-46-7	1,4-Dichlorobenzene	LT .14	UGG			
								106-47-8	4-Chloroaniline	LT .14	UGG			
								108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG			
								108-95-2	Phenol / Carboic acid / Phenic acid / Phenylc acid / Phe*	LT .14	UGG			
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG			
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG			
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG			
								117-84-0	Di-n-octyl phthalate	LT .14	UGG			
								118-74-1	Hexachlorobenzene	LT .14	UGG			
								120-12-7	Anthracene	LT .14	UGG			
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG			
								120-83-2	2,4-Dichlorophenol	LT .14	UGG			
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG			
								129-00-0	Benzo[def]phenanthrene / Pyrene	6.9 E -2	UGG JP			
								131-11-3	Dimethyl phthalate	LT .14	UGG			

132-64-9	Dibenzofuran	LT .14	UGG
191-24-2	Benzo[ghi]perylene	LT .14	UGG
193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG
205-99-2	Benzo[b]fluoranthene / 3,4-	LT .14	UGG
	Benzo[fluoranthene		
206-44-0	Fluoranthene	1.3 E -2	UGG JP
207-08-9	Benzo[k]fluoranthene	LT .14	UGG
208-96-8	Acenaphthylene	LT .14	UGG
218-01-9	Chrysene	LT .14	UGG
50-32-8	Benzo[a]pyrene	LT .14	UGG
51-28-5	2,4-Dinitrophenol	LT .14	UGG
53-70-3	Dibenz[ah]anthracene / 1,2:5,6-	LT .14	UGG
	Dibenzanthracene		
534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-	LT .14	UGG
	dinitrophenol		
541-73-1	1,3-Dichlorobenzene	LT .14	UGG
56-55-3	Benzo[a]anthracene	LT .14	UGG
59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-	LT .14	UGG
	cresol / 4-Chloro-3-m*		
606-20-2	2,6-Dinitrotoluene	LT .14	UGG
621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG
65-85-0	Benzoic acid	1.4 E -2	UGG JP
67-72-1	Hexachloroethane	LT .14	UGG
77-47-4	Hexachlorocyclopentadiene	LT .14	UGG
78-59-1	Isophorone	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 163 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-3	SAIC01	0.0	16-MAY-97	UB	97U01646	SMV3/S	83-32-9	Acenaphthene	LT .14	UGG		
								84-66-2	Diethyl phthalate	LT .14	UGG		
								84-74-2	Di-n-butyl phthalate	LT .14	UGG		
								85-01-8	Phenanthrene	LT .14	UGG		
								85-68-7	Butylbenzyl phthalate	LT .14	UGG		
								86-30-6	N-Nitrosodiphenylamine	LT .14	UGG		
								86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG		
								86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG		
								87-68-3	Hexachlorobutadiene / Hexachloro-1,3-	LT .14	UGG		
									butadiene				
								87-86-5	Pentachlorophenol	LT .14	UGG		

88-06-2	2,4,6-Trichlorophenol	LT .14	UGG
89-74-4	2-Nitroaniline	LT .14	UGG
89-75-5	2-Nitrophenol	LT .14	UGG
91-20-3	Naphthalene / Tar camphor	LT .14	UGG
91-57-6	2-Methylnaphthalene	LT .14	UGG
91-58-7	2-Chloronaphthalene	LT .14	UGG
91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG
95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG
95-50-1	1,2-Dichlorobenzene	LT .14	UGG
95-57-8	2-Chlorophenol	LT .14	UGG
95-95-4	2,4,5-Trichlorophenol	LT .14	UGG
98-95-3	Nitrobenzene / Essence of mirbane /	LT .14	UGG
99-09-2	Oil of mirbane		
	3-Nitroaniline	LT .14	UGG
	4-Bromophenyl phenyl ether	LT .14	UGG
	4-Chlorophenyl phenyl ether	LT .14	UGG
	Ethylbenzene	LT 1.0 E -2	UGG
	Styrene / Ethenylbenzene / Styrol /	LT 1.0 E -2	UGG
	Styrolene / Cinnamene *		
	cis-1,3-Dichloropropylene / cis-1,3-	LT 1.0 E -2	UGG
	Dichloropropene		
	1,2-Dichloroethane	LT 1.0 E -2	UGG
	Vinyl acetate / Acetic acid vinyl	LT 1.0 E -2	UGG
	ester		
	Methyl isobutyl ketone /	LT 1.0 E -2	UGG
	Isopropylacetone / 4-Methyl-2-pen*		
	Toluene	LT 1.0 E -2	UGG
	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG
	2-Chloroethyl vinyl ether / (2-	LT 1.0 E -2	UGG
	Chloroethoxy)ethene		
	Dibromochloromethane /	LT 1.0 E -2	UGG
	Chlorodibromomethane		

VMS4/S

\* - Analyte Description has been truncated. See Data Dictionary

- 164 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Matrix	Meth/ CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-1MLF7-3	SAIC01	0.0	16-MAY-97	UB	97U01646	VMS4/S	127-18-4	Tetrachloroethylene /			
								156-59-2	Tetrachloroethene / Perchloroethylen*			
									cis-1,2-Dichloroethylene / cis-1,2-			



Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-4	SAIC01	0.0	16-MAY-97	ES	SNSA*700 HBGI/S	88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butyphenol / 2-sec-Butyl-4,6-245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
							93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
							93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We+	LT 1.00 E -2	UGG	?	
							94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolylo	LT .2	UGG	?	
							94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG	?	
							94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG	?	
	UB	97U01647	EXL4/S				118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG		
							121-14-2	2,4-Dinitrotoluene	LT .1	UGG		
							121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
							2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
							479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
							606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
							88-72-2	2-Nitrotoluene	LT .4	UGG		
							98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
							99-08-1	3-Nitrotoluene	LT .4	UGG		
							99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
							99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
							99-99-0	4-Nitrotoluene	LT .4	UGG		
								2-Amino-4,6-dinitrotoluene	LT .2	UGG		
								4-Amino-2,6-dinitrotoluene	LT .2	UGG		
								Arsenic	1.91	UGG		
								Lead	6.4	UGG		
								Antimony	LT .305	UGG		
								Selenium	LT .25	UGG		
								Thallium	LT .2	UGG		
								Mercury	LT .1	UGG		
								Aluminum	2700	UGG		
								Iron	8640	UGG		
								Magnesium	22300	UGG		
								Manganese	203	UGG		
								Molybdenum	LT 1	UGG	J	
								Nickel	6.13	UGG		
								Potassium	426	UGG		
								Silver	LT .5	UGG	J	

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMF7-4	SAIC01	0.0	16-MAY-97	UB	97U01647	ICP3/S	7440-23-5	Sodium	422	UGG		
								7440-31-5	Tin	6.25	UGG	J	
								7440-39-3	Barium	9.89	UGG JP		
								7440-41-7	Beryllium	.149	UGG JP		
								7440-42-8	Boron	7.05	UGG		
								7440-43-9	Cadmium	.415	UGG JP		
								7440-47-3	Chromium	7.03	UGG		
								7440-48-4	Cobalt	3.56	UGG		
								7440-50-8	Copper	4.44	UGG		
								7440-62-2	Vanadium	32.5	UGG		
								7440-66-6	Zinc	58.2	UGG		
								7440-70-2	Calcium	45200	UGG		
							PST2/S	1024-57-3	Heptachlor epoxide	2.88 E -4	UGG JP		
								1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG		
								1104-28-2	PCB 1221	LT 1.30 E -2	UGG		
								11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
								309-00-2	Aldrin	5.03 E -4	UGG JP		
								319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	9.74 E -4	UGG BJP		
								319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	7.48 E -4	UGG BJP		
								319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.08 E -3	UGG BJP		
								33213-65-9	Endosulfan II / beta-Endosulfan	4.66 E -4	UGG JP		
								50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	1.54 E -3	UGG C		
								5103-71-9	alpha-Chlordane	3.84 E -4	UGG JP	I	
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG		
								53494-70-5	Endrin ketone	LT 1.00 E -3	UGG		
								5566-34-7	gamma-Chlordane	3.47 E -4	UGG JP		
								58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc*	8.45 E -4	UGG JP		
								60-57-1	Dieldrin	3.36 E -4	UGG JP		
								72-20-8	Endrin	5.11 E -4	UGG BJP		
								72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-	1.44 E -3	UGG JP		



\* - Analyte Description has been truncated. See Data Dictionary

- 167 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-4	SAIC01	0.0	16-MAY-97	UB	97U01647	7421-93-4 76-44-8	Endrin aldehyde Heptachlor / 1H-1,4,5,6,7,8,8- Heptachloro-3a,4,7,7a-tetra*	LT 1.00 E -3 4.42 E -4	UGG JP UGG JP		
							8001-35-2	Toxaphene / Chlorinated camphene / Campechlor / Alltox / *	LT .1	UGG		
							959-98-8	Endosulfan I / alpha-Endosulfan	4.75 E -4	UGG JP		
						SMV3/S	100-01-6	4-Nitroaniline	LT .14	UGG		
							100-02-7	4-Nitrophenol	LT .14	UGG		
							100-51-6	Benzyl alcohol	LT .14	UGG		
							105-67-9	2,4-Dimethylphenol	LT .14	UGG		
							106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG		
							106-46-7	1,4-Dichlorobenzene	LT .14	UGG		
							106-47-8	4-Chloroaniline	LT .14	UGG		
							108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG		
							108-95-2	Phenol / Carbolic acid / Phenic acid / Phenylic acid / Phe*	LT .14	UGG		
							111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG		
							111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG		
							117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG		
							117-84-0	Di-n-octyl phthalate	LT .14	UGG		
							118-74-1	Hexachlorobenzene	LT .14	UGG		
							120-12-7	Anthracene	LT .14	UGG		
							120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
							120-83-2	2,4-Dichlorophenol	LT .14	UGG		
							121-14-2	2,4-Dinitrotoluene	LT .14	UGG		
							129-00-0	Benzo[def]phenanthrene / Pyrene	1.7 E -2	UGG JP		
							131-11-3	Dimethyl phthalate	LT .14	UGG		
							132-64-9	Dibenzofuran	LT .14	UGG		
							191-24-2	Benzo[ghi]perylene	LT .14	UGG		
							193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG		
							205-99-2	Benzo[b]fluoranthene / 3,4-	LT .14	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

- 168 -

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CMS No.	Analyte Description	Me Bo Conc	Unit Flag	Data Quals	EPA Data Quals
LAKE	SD-1MLF7-4	SAIC01	0.0	16-MAY-97	UB	97U01647	SNV3/S	59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG	---	---
								606-20-2	2,6-Dinitrotoluene	LT .14	UGG	---	---
								621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG	---	---
								63-85-0	Benzoic acid	LT .14	UGG	---	---
								67-72-1	Hexachloroethane	LT .14	UGG	---	---
								77-47-4	Hexachlorocyclopentadiene	LT .14	UGG	---	---
								78-59-1	Isophorone	LT .14	UGG	---	---
								83-32-9	Acenaphthene	LT .14	UGG	---	---
								84-66-2	Diethyl phthalate	LT .14	UGG	---	---
								84-74-2	Di-n-butyl phthalate	LT .14	UGG	---	---
								85-01-8	Phenanthrene	LT .14	UGG	---	---
								85-68-7	Butylbenzyl phthalate	LT .14	UGG	---	---
								86-30-6	N-Nitrosodiphenylamine	LT .14	UGG	---	---
								86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG	---	---
								86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG	---	---
								87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG	---	---
								87-86-5	Pentachlorophenol	LT .14	UGG	---	---
								88-06-2	2,4,6-Trichlorophenol	LT .14	UGG	---	---
								88-74-4	2-Nitroaniline	LT .14	UGG	---	---
								88-75-5	2-Nitrophenol	LT .14	UGG	---	---
								91-20-3	Naphthalene / Tar camphor	LT .14	UGG	---	---

206-44-0 Benzo[fluoranthene] LT .14 UGG  
 207-08-9 Fluoranthene LT .14 UGG  
 208-96-8 Benzo[k]fluoranthene LT .14 UGG  
 218-01-9 Acenaphthylene LT .14 UGG  
 50-32-8 Chrysene LT .14 UGG  
 51-28-5 Benzo[a]pyrene LT .14 UGG  
 53-70-3 2,4-Dinitrophenol LT .14 UGG  
 534-52-1 Dibenz[ah]anthracene / 1,2:5,6- LT .14 UGG  
 541-73-1 4,6-Dinitro-2-cresol / 2-Methyl-4,6- dinitrophenol LT .14 UGG  
 56-55-3 1,3-Dichlorobenzene LT .14 UGG  
 Benzo[a]anthracene

91-57-6	2-Methylnaphthalene	LT .14	UGG
91-58-7	2-Chloronaphthalene	LT .14	UGG
91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG
95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG
95-50-1	1,2-Dichlorobenzene	LT .14	UGG
95-57-8	2-Chlorophenol	LT .14	UGG
95-95-4	2,4,5-Trichlorophenol	LT .14	UGG
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG
99-09-2	3-Nitroaniline	LT .14	UGG
	4-Bromophenyl phenyl ether	LT .14	UGG
	4-Chlorophenyl phenyl ether	LT .14	UGG
VMS4/S 100-41-4	Ethylbenzene	LT 1.0 E -2	UGG
100-42-5	Styrene / Ethylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG
10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG
107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG
108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG
108-10-1			

\* - Analyte Description has been truncated. See Data Dictionary

- 169 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-1MLF7-4	SAIC01	0.0	16-MAY-97	UB	97U01647	VMS4/S	108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG			
								108-88-3	Toluene	LT 1.0 E -2	UGG			
								108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG			
								110-75-8	2-Chloroethyl vinyl ether / (2-Chloroethoxy)ethene	LT 1.0 E -2	UGG			
								124-48-1	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG			
								127-18-4	Tetrachloroethylene / Perchloroethylen*	LT 1.0 E -2	UGG			
								156-59-2	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG			
								156-60-5	trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG			
								56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG			

Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag	Data Quals	EPA Data Quals
SD-LMLF7-5	SAIC01	0.0	16-MAY-97	ES	SNSA*604	HBG1/S	120-36-5	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG		JP
67-64-1								Acetone	6.4 E -3	UGG		
67-66-3								Chloroform	LT 1.0 E -2	UGG		
71-43-2								Benzene	LT 1.0 E -2	UGG		
71-55-6								1,1,1-Trichloroethane	LT 1.0 E -2	UGG		
74-83-9								Bromomethane	LT 1.0 E -2	UGG		
74-87-3								Chloromethane	LT 1.0 E -2	UGG		
75-00-3								Chloroethane	LT 1.0 E -2	UGG		
75-01-4								Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG		
75-09-2								Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG		
75-15-0								Carbon disulfide	LT 1.0 E -2	UGG		
75-25-2								Bromoform	LT 1.0 E -2	UGG		
75-27-4								Bromodichloromethane	LT 1.0 E -2	UGG		
75-34-3								1,1-Dichloroethane	LT 1.0 E -2	UGG		
75-35-4								1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG		
75-43-4								Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG		
75-69-4								Trichlorofluoromethane	LT 1.0 E -2	UGG		
78-87-5								1,2-Dichloropropane	LT 1.0 E -2	UGG		
78-93-3								Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG		
79-00-5								1,1,2-Trichloroethane	LT 1.0 E -2	UGG		
79-01-6								Trichloroethylene / Trichloroethene / Ethinyl trichloride / T	LT 1.0 E -2	UGG		
79-34-5								Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG		
								Xylenes, total combined	LT 1.0 E -2	UGG		
								trans-1,3-Dichloropropene	LT 1.0 E -2	UGG		
								2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG		
								Dichloroprop				

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

- 170 -

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-5	SAIC01	0.0	16-MAY-97	ES	SNSA*604	HBG1/S	1918-00-9	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG		
								7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP *	LT .2	UGG		
								75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichloro	LT 1.00 E -2	UGG		

88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG
93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG
93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / Wa*	LT 1.00 E -2	UGG
94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolylo*	LT .2	UGG
94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG
94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG
118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG
121-14-2	2,4-Dinitrotoluene	LT .1	UGG
121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG
2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG
479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG
606-20-2	2,6-Dinitrotoluene	LT .2	UGG
88-72-2	2-Nitrotoluene	LT .4	UGG
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG
99-08-1	3-Nitrotoluene	LT .4	UGG
99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG
99-65-0	1,3-Dinitrobenzene	LT .1	UGG
99-99-0	4-Nitrotoluene	LT .4	UGG
	2-Amino-4,6-dinitrotoluene	LT .2	UGG
	4-Amino-2,6-dinitrotoluene	LT .2	UGG
	Arsenic	2.39	UGG
	Lead	7.59	UGG
	Antimony	LT .305	UGG
	Selenium	LT .25	UGG
	Thallium	LT .2	UGG
	Mercury	LT .1	UGG
	Aluminum	2290	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 171 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Meth/ Matrix	Lab Anly. No.	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
-----------	---------	------------------	-------	-------------	------------------	---------------	---------	---------------------	------------	-----------	------------	------------	----------------



30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation : Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-5	SAIC01	0.0	16-MAY-97	UB	97U01648	PST2/S	72-20-8 72-43-5	Endrin Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethyl)ide*	4.92 E -4 1.79 E -3	UGG BJP UGG JP		
								72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	3.58 E -3	UGG C		
								72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	1.13 E -3	UGG JP		
								7421-93-4 76-44-8	Endrin aldehyde Heptachlor / 1H-1,4,5,6,7,8-Heptachloro-3a,4,7,7a-tetra*	LT 1.00 E -3 3.15 E -4	UGG UGG JP		
								8001-35-2	Toxaphene / Chlorinated camphene / Camphchlor / Alltox / *	LT .1	UGG		
								959-98-8 100-01-6 100-02-7	Endosulfan I / alpha-Endosulfan 4-Nitroaniline 4-Nitrophenol	3.22 E -4 LT .14 LT .14	UGG JP UGG UGG		
								100-51-6 105-67-9	Benzyl alcohol 2,4-Dimethylphenol	LT .14 LT .14	UGG UGG		
								106-44-5 106-46-7	p-Cresol / 4-Cresol / 4-Methylphenol 1,4-Dichlorobenzene	LT .14 LT .14	UGG UGG		
								106-47-8 108-60-1 108-95-2	4-Chloroaniline Bis(2-chloroisopropyl) ether Phenol / Carboic acid / Phenic acid / Phenyl acid / Phe*	LT .14 LT .14 LT .14	UGG UGG UGG		
								111-44-4 111-91-1 117-81-7 117-84-0 118-74-1 120-12-7 120-82-1 120-83-2 121-14-2 129-00-0 131-11-3 132-64-9 191-24-2 193-39-5 205-99-2	Bis(2-chloroethyl) ether Bis(2-chloroethoxy) methane Bis(2-ethylhexyl) phthalate Di-n-octyl phthalate Hexachlorobenzene Anthracene 1,2,4-Trichlorobenzene 2,4-Dichlorophenol 2,4-Dinitrotoluene Benzo[def]phenanthrene / Pyrene Dimethyl phthalate Dibenzofuran Benzo[ghi]perylene Indeno[1,2,3-C,D]pyrene Benzo[b]fluoranthene / 3,4-Benzofluoranthene	LT .14 LT .14 LT .14 LT .14 LT .14 LT .14 LT .14 LT .14 LT .14 LT .14 LT .14 LT .14 LT .14 LT .14 LT .14 LT .14	UGG UGG UGG UGG UGG UGG UGG UGG UGG UGG UGG UGG UGG UGG UGG UGG UGG		
								206-44-0 207-08-9 208-96-8 218-01-9	Fluoranthene Benzo[k]fluoranthene Acenaphthylene Chrysene	1.5 E -2 LT .14 LT .14 LT .14	UGG JP UGG UGG UGG		

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-5	SAIC01	0.0	16-MAY-97	UB	97U01648	SMV3/S	51-28-5	2,4-Dinitrophenol	LT .14	UGG		
								53-70-3	Dibenz[ah]anthracene / 1,2:5,6- Dibenzanthracene	LT .14	UGG		
								534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6- dinitrophenol	LT .14	UGG		
								541-73-1	1,3-Dichlorobenzene	LT .14	UGG		
								56-55-3	Benzo[a]anthracene	LT .14	UGG		
								59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3- cresol / 4-Chloro-3-m*	LT .14	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .14	UGG		
								621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG		
								65-85-0	Benzoic acid	LT .14	UGG		
								67-72-1	Hexachloroethane	LT .14	UGG		
								77-47-4	Hexachlorocyclopentadiene	LT .14	UGG		
								78-59-1	Isophorone	LT .14	UGG		
								83-32-9	Acenaphthene	LT .14	UGG		
								84-66-2	Diethyl phthalate	LT .14	UGG		
								84-74-2	Di-n-butyl phthalate	LT .14	UGG		
								85-01-8	Phenanthrene	LT .14	UGG		
								85-68-7	Butylbenzyl phthalate	LT .14	UGG		
								86-30-6	N-Nitrosodiphenylamine	LT .14	UGG		
								86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG		
								86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG		
								87-68-3	Hexachlorobutadiene / Hexachloro-1,3- butadiene	LT .14	UGG		
								87-86-5	Pentachlorophenol	LT .14	UGG		
								88-06-2	2,4,6-Trichlorophenol	LT .14	UGG		
								88-74-4	2-Nitroaniline	LT .14	UGG		
								88-75-5	2-Nitrophenol	LT .14	UGG		
								91-20-3	Naphthalene / Tar camphor	LT .14	UGG		
								91-57-6	2-Methylnaphthalene	LT .14	UGG		
								91-58-7	2-Chloronaphthalene	LT .14	UGG		
								91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG		
								95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG		
								95-50-1	1,2-Dichlorobenzene	LT .14	UGG		



95-57-8	2-Chlorophenol	LT .14	UGG
95-95-4	2,4,5-Trichlorophenol	LT .14	UGG
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG
99-09-2	3-Nitroaniline	LT .14	UGG
	4-Bromophenyl phenyl ether	LT .14	UGG
	4-Chlorophenyl phenyl ether	LT .14	UGG
	Ethylbenzene	LT 1.0 E -2	UGG

VMS4/S 100-41-4  
100-42-5

\* - Analyte Description has been truncated. See Data Dictionary

- 174 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-5	SAIC01	0.0	16-MAY-97	UB	97U01648	VMS4/S	100-42-5	Styrene / Ethylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG			
								10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG			
								107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG			
								108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG			
								108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG			
								108-88-3	Toluene	LT 1.0 E -2	UGG			
								108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG			
								110-75-8	2-Chloroethyl vinyl ether / (2-Chloroethoxy)ethene	LT 1.0 E -2	UGG			
								124-48-1	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG			
								127-18-4	Tetrachloroethylene / Perchloroethylen*	LT 1.0 E -2	UGG			
								156-59-2	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG			
								156-60-5	trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG			
								56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG			
								591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG			
								67-64-1	Acetone	5.3 E -2	UGG			
								67-66-3	Chloroform	LT 1.0 E -2	UGG			
								71-43-2	Benzene	LT 1.0 E -2	UGG			
								71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG			

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

- 175 -

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-5	SAIC01	0.0	16-MAY-97	UB	97U01648	VMS4/S	79-01-6	Trichloroethylene / Trichloroethene / Ethinyl trichloride / T*	LT 1.0 E -2	UGG		
								79-34-5	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG		
									Xylenes, total combined	LT 1.0 E -2	UGG		
									trans-1,3-Dichloropropene	LT 1.0 E -2	UGG		
									2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG D		
	SAIC01D		0.0	16-MAY-97	ES	SN5A*678	H8G1/S	120-36-5	Dichloroprop				
								1918-00-9	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG D		
								7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP / *	LT .2	UGG D		
								75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichloro-	LT 1.00 E -2	UGG D		
								88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG D		
								93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG D		

74-83-9	Bromomethane	LT 1.0 E -2	UGG	
74-87-3	Chloromethane	LT 1.0 E -2	UGG	
75-00-3	Chloroethane	LT 1.0 E -2	UGG	
75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG	
75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG	
75-15-0	Carbon disulfide	LT 1.0 E -2	UGG	
75-25-2	Bromoform	LT 1.0 E -2	UGG	
75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG	
75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG	
75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG	
75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG	
75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG	
78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG	
78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG	
79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG	
79-01-6				

93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG D
94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolylo*	LT .2	UGG D
94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG D
94-82-6	2,4-DB / 4-[2,4-Dichlorophenoxy]butyric acid	LT 1.00 E -2	UGG D
118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG D
121-14-2	2,4-Dinitrotoluene	LT .1	UGG D
121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG D
2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG D
479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG D
606-20-2	2,6-Dinitrotoluene	LT .2	UGG D
88-72-2	2-Nitrotoluene	LT .4	UGG D
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG D
99-08-1	3-Nitrotoluene	LT .4	UGG D
99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG D
99-65-0	1,3-Dinitrobenzene	LT .1	UGG D
99-99-0	4-Nitrotoluene	LT .4	UGG D
	2-Amino-4,6-dinitrotoluene	LT .2	UGG D

\* - Analyte Description has been truncated. See Data Dictionary

- 176 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-1MLF7-5	SAIC01D	0.0	16-MAY-97	UB	97U01649	EXL4/S	4-Amino-2,6-dinitrotoluene	LT .2	UGG D		
							GAS2/S	Arsenic	2.18	UGG D		
							GPB1/S	Lead	6.89	UGG D		
							GSB2/S	Antimony	LT .305	UGG D		
							GSE2/S	Selenium	LT .25	UGG D		
							GTL2/S	Thallium	LT .2	UGG D		
							HGC1/S	Mercury	LT .1	UGG D		
							ICP3/S	Aluminum	2830	UGG D		
								Iron	10400	UGG D		
								Magnesium	29400	UGG D		
								Manganese	230	UGG D		

7439-98-7	Molybdenum	LT 1	UGG D	J
7440-02-0	Nickel	6.07	UGG D	
7440-09-7	Potassium	529	UGG D	
7440-22-4	Silver	LT .5	UGG D	J
7440-23-5	Sodium	483	UGG D	
7440-31-5	Tin	LT 5	UGG D	J
7440-39-3	Barium	12	UGG JPD	
7440-41-7	Beryllium	.182	UGG JPD	
7440-42-8	Boron	9.17	UGG D	
7440-43-9	Cadmium	LT .5	UGG D	
7440-47-3	Chromium	8.8	UGG D	
7440-48-4	Cobalt	2.51	UGG D	
7440-50-8	Copper	4.2	UGG D	
7440-62-2	Vanadium	38.7	UGG D	
7440-66-6	Zinc	46.9	UGG D	
7440-70-2	Calcium	62000	UGG D	
PST2/S 1024-57-3	Heptachlor epoxide	3.35 E -4	UGG DJP	
1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG D	
1104-28-2	PCB 1221	LT 1.30 E -2	UGG D	
11096-82-5	PCB 1260	LT 1.30 E -2	UGG D	
11097-69-1	PCB 1254	LT 1.30 E -2	UGG D	
11141-16-5	PCB 1232	LT 1.30 E -2	UGG D	
12672-29-6	PCB 1248	LT 1.30 E -2	UGG D	
12674-11-2	PCB 1016	LT 1.30 E -2	UGG D	
309-00-2	Aldrin	5.40 E -4	UGG DJP	
319-84-6	alpha-Hexachlorocyclohexane / alpha-	8.80 E -4	UGG BDJP	
	Benzene hexachloride			
319-85-7	beta-Hexachlorocyclohexane / beta-	6.93 E -4	UGG BDJP	
	Benzene hexachloride			
319-86-8	delta-Hexachlorocyclohexane / delta-	1.45 E -3	UGG BDU	
	Benzene hexachloride			
33213-65-9	Endosulfan II / beta-Endosulfan	LT 1.00 E -3	UGG D	
50-29-3				

\* - Analyte Description has been truncated. See Data Dictionary

- 177 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Matrix	Meth/	Analyste Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-5	SAIC01D	0.0	16-MAY-97	97001649	UB	PST2/S	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	1.40 E -3	UGG CD	---	---
					5103-71-9			alpha-Chlordane	3.69 E -4	UGG DJP	I	

53469-21-9	PCB 1242	LT 1.30 E -2	UGG D
53494-70-5	Endrin ketone	LT 1.00 E -3	UGG D
5566-34-7	gamma-Chlordane	3.51 E -4	UGG DJP
58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc*	7.53 E -4	UGG DJP
60-57-1	Dieldrin	4.05 E -4	UGG DJP
72-20-8	Endrin	4.95 E -4	UGG BDJP
72-43-5	Methoxychlor / Methoxy-DDT / 1,1'- (2,2,2-Trichloroethylide)*	1.44 E -3	UGG DJP
72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p- chlorophenyl)ethane / Rhoth*	2.73 E -3	UGG CD
72-55-9	2,2-Bis(p-chlorophenyl)-1,1- dichloroethene	8.96 E -4	UGG DJP
7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG D
76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8- Heptachloro-3a,4,7,7a-tetra*	3.29 E -4	UGG DJP
8001-35-2	Toxaphene / Chlorinated camphene / Campechlor / Alltox / *	LT .1	UGG D
959-98-8	Endosulfan I / alpha-Endosulfan	3.32 E -4	UGG DJP
100-01-6	4-Nitroaniline	LT .14	UGG D
100-02-7	4-Nitrophenol	LT .14	UGG D
100-51-6	Benzyl alcohol	LT .14	UGG D
105-67-9	2,4-Dimethylphenol	LT .14	UGG D
106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG D
106-46-7	1,4-Dichlorobenzene	LT .14	UGG D
106-47-8	4-Chloroaniline	LT .14	UGG D
108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG D
108-95-2	Phenol / Carbolic acid / Phenic acid / Phenyllic acid / Phe*	LT .14	UGG D
111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG D
111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG D
117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG D
117-84-0	Di-n-octyl phthalate	LT .14	UGG D
118-74-1	Hexachlorobenzene	LT .14	UGG D
120-12-7	Anthracene	LT .14	UGG D
120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG D
120-83-2	2,4-Dichlorophenol	LT .14	UGG D
121-14-2	2,4-Dinitrotoluene	LT .14	UGG D
129-00-0	Benzo(def)phenanthrene / Pyrene	1.7 E -2	UGG DJP
131-11-3	Dimethyl phthalate	LT .14	UGG D
132-64-9	Dibenzofuran	LT .14	UGG D

- 178 -

\* - Analyte Description has been truncated. See Data Dictionary

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-5	SAIC01D	0.0	16-MAY-97	UB	97U01649	SMV3/S	191-24-2	Benzo[ghi]perylene	LT .14	UGG D		
								193-39-5	Indeno[1,2,3-C,Di]pyrene	LT .14	UGG D		
								205-99-2	Benzo[b]fluoranthene / 3,4-Benzo[fluoranthene	LT .14	UGG D		
								206-44-0	Fluoranthene	1.3 E -2	UGG DJP		
								207-08-9	Benzo[k]fluoranthene	LT .14	UGG D		
								208-96-8	Acenaphthylene	LT .14	UGG D		
								218-01-9	Chrysene	LT .14	UGG D		
								50-32-8	Benzo[a]pyrene	LT .14	UGG D		
								51-28-5	2,4-Dinitrophenol	LT .14	UGG D		
								53-70-3	Dibenz[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG D		
								534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG D		
								541-73-1	1,3-Dichlorobenzene	LT .14	UGG D		
								56-55-3	Benzo[a]anthracene	LT .14	UGG D		
								59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG D		
								606-20-2	2,6-Dinitrotoluene	LT .14	UGG D		
								621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG D		
								65-85-0	Benzoic acid	LT .14	UGG D		
								67-72-1	Hexachloroethane	LT .14	UGG D		
								77-47-4	Hexachlorocyclopentadiene	LT .14	UGG D		
								78-59-1	Isophorone	LT .14	UGG D		
								83-32-9	Acenaphthene	LT .14	UGG D		
								84-66-2	Diethyl phthalate	LT .14	UGG D		
								84-74-2	Di-n-butyl phthalate	LT .14	UGG D		
								85-01-8	Phenanthrene	LT .14	UGG D		
								85-68-7	Butylbenzyl phthalate	LT .14	UGG D		
								86-30-6	N-Nitrosodiphenylamine	LT .14	UGG D		
								86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG D		
								86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG D		
								87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG D		
								87-86-5	Pentachlorophenol	LT .14	UGG D		
								88-06-2	2,4,6-Trichlorophenol	LT .14	UGG D		
								88-74-4	2-Nitroaniline	LT .14	UGG D		
								88-75-5	2-Nitrophenol	LT .14	UGG D		
								91-20-3	Naphthalene / Tar camphor	LT .14	UGG D		
								91-57-6	2-Methylnaphthalene	LT .14	UGG D		
								91-58-7	2-Chloronaphthalene	LT .14	UGG D		
								91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG D		
								95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG D		
								95-50-1	1,2-Dichlorobenzene	LT .14	UGG D		

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-5	SAIC01D	0.0	16-MAY-97	UB	97U01649	SMV3/S	95-57-8	2-Chlorophenol	LT .14	UGG D	
							95-95-4	2,4,5-Trichlorophenol	LT .14	UGG D		
							98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG D		
							99-09-2	3-Nitroaniline	LT .14	UGG D		
								4-Bromophenyl phenyl ether	LT .14	UGG D		
								4-Chlorophenyl phenyl ether	LT .14	UGG D		
								Ethylbenzene	LT 1.0 E -2	UGG D		
								Styrene / Ethylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG D		
							100-41-4					
							100-42-5					
							10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG D		
							107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG D		
							108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG D		
							108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG D		
							108-88-3	Toluene	LT 1.0 E -2	UGG D		
							108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG D		
							110-75-8	2-Chloroethyl vinyl ether / 12-Chloroethoxyethene	LT 1.0 E -2	UGG D		
							124-48-1	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG D		
							127-18-4	Tetrachloroethylene / Perchloroethylen*	LT 1.0 E -2	UGG D		
							156-59-2	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG D		
							156-60-5	trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG D		
							56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG D		
							591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG D		
							67-64-1	Acetone	.23	UGG D		
							67-66-3	Chloroform	LT 1.0 E -2	UGG D		
							71-43-2	Benzene	LT 1.0 E -2	UGG D		
							71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG D		
							74-83-9	Bromomethane	LT 1.0 E -2	UGG D		
							74-87-3	Chloromethane	LT 1.0 E -2	UGG D		
							75-00-3	Chloroethane	LT 1.0 E -2	UGG D		
							75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG D		

\* - Analyte Description has been truncated. See Data Dictionary

- 180 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-5	SAIC01D	0.0	16-MAY-97	UB	97U01649 VMS4/S	75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG D		
							75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG D		
							75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG D		
							78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG D		
							78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG D		
							79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG D		
							79-01-6	Trichloroethylene / Trichloroethene / Ethinyl trichloride / T*	LT 1.0 E -2	UGG D		
							79-34-5	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG D		
								Xylenes, total combined	LT 1.0 E -2	UGG D		
								trans-1,3-Dichloropropene	LT 1.0 E -2	UGG D		
SD-LMLF7-6	SAIC01		0.0	16-MAY-97	ES	SNSA*680 HBGI/S	120-36-5	2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG		
							1918-00-9	Dichloroprop	LT 1.00 E -2	UGG		
								Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG		
							7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP / *	LT .2	UGG		
							75-99-0	Dalapon / alpha, alpha-Dichloropropionic acid / 2,2-Dichlor*	LT 1.00 E -2	UGG		
							88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG		
							93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG		
							93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG		
							94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolyl)*	LT .2	UGG		
							94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic	LT 1.00 E -2	UGG		



\* - Analyte Description has been truncated. See Data Dictionary

- 181 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-6	SAIC01	0.0	16-MAY-97	UB	97U01650	EXL4/S	98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
								99-08-1	3-Nitrotoluene	LT .4	UGG		
								99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
								99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
								99-99-0	4-Nitrotoluene	LT .4	UGG		
									2-Amino-4,6-dinitrotoluene	LT .2	UGG		
									4-Amino-2,6-dinitrotoluene	LT .2	UGG		
							GBS2/S	7440-38-2	Arsenic	2.12	UGG		
							GPB1/S	7439-92-1	Lead	14	UGG		
							GSB2/S	7440-36-0	Antimony	LT .305	UGG		
							GSE2/S	7782-49-2	Selenium	LT .25	UGG		
							GTL2/S	7440-28-0	Thallium	LT .2	UGG		
							HGCI/S	7439-97-6	Mercury	LT .1	UGG		
							ICP3/S	7429-90-5	Aluminum	2520	UGG		
								7439-89-6	Iron	11200	UGG		
								7439-95-4	Magnesium	23500	UGG		
								7439-96-5	Manganese	217	UGG		
								7439-98-7	Molybdenum	1.87	UGG	J	
								7440-02-0	Nickel	5.83	UGG		
								7440-09-7	Potassium	481	UGG		
								7440-22-4	Silver	LT .5	UGG	J	
								7440-23-5	Sodium	394	UGG		

7440-31-5	Tin	LT 5	UGG	J
7440-39-3	Barium	7.88	UGG	JP
7440-41-7	Beryllium	LT .5	UGG	
7440-42-8	Boron	9.98	UGG	
7440-43-9	Cadmium	LT .5	UGG	
7440-47-3	Chromium	9.35	UGG	
7440-48-4	Cobalt	2.83	UGG	
7440-50-8	Copper	3.95	UGG	
7440-62-2	Vanadium	40.5	UGG	
7440-66-6	Zinc	42.9	UGG	
7440-70-2	Calcium	48100	UGG	
PST2/S	Heptachlor epoxide	3.10 E -4	UGG	JP
1024-57-3	Endosulfan sulfate	LT 1.00 E -3	UGG	
1031-07-8	PCB 1221	LT 1.30 E -2	UGG	
1104-28-2	PCB 1260	LT 1.30 E -2	UGG	
11096-82-5	PCB 1254	LT 1.30 E -2	UGG	
11097-69-1	PCB 1232	LT 1.30 E -2	UGG	
11141-16-5	PCB 1248	LT 1.30 E -2	UGG	
12672-29-6	PCB 1016	LT 1.30 E -2	UGG	
12674-11-2	Aldrin	6.86 E -4	UGG	JP
309-00-2				
319-84-6				

\* - Analyte Description has been truncated. See Data Dictionary

- 182 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-6	SAIC01	0.0	16-MAY-97	UB	97U01650	PST2/S	319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	9.11 E -4	UGG BJP		
								319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	5.87 E -4	UGG BJP		
								319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.05 E -3	UGG BJP		
								33213-65-9	Endosulfan II / beta-Endosulfan	LT 1.00 E -3	UGG		
								50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	1.40 E -3	UGG C		
								5103-71-9	alpha-Chlordane	3.56 E -4	UGG JP	I	
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG		
								53494-70-5	Endrin ketone	LT 1.00 E -3	UGG		
								5566-34-7	gamma-Chlordane	3.37 E -4	UGG JP		
								58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyclopentadiene	7.85 E -4	UGG JP		

60-57-1	Dieldrin	3.32 E -4	UGG JP
72-20-8	Endrin	4.39 E -4	UGG BJP
72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethylidene*)	1.32 E -3	UGG JP
72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	2.85 E -3	UGG C
72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	9.90 E -4	UGG JP
7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG
76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetra*	3.46 E -4	UGG JP
8001-35-2	Toxaphene / Chlorinated camphene / Camphchlor / Alltox / *	LT .1	UGG
959-98-8	Endosulfan I / alpha-Endosulfan	3.05 E -4	UGG JP
SNV3/S	4-Nitroaniline	LT .14	UGG
100-01-6	4-Nitrophenol	LT .14	UGG
100-02-7	Benzyl alcohol	LT .14	UGG
100-51-6	2,4-Dimethylphenol	LT .14	UGG
105-67-9	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG
106-44-5	1,4-Dichlorobenzene	LT .14	UGG
106-46-7	4-Chloroaniline	LT .14	UGG
106-47-8	Bis(2-chloroisopropyl) ether	LT .14	UGG
108-60-1	Phenol / Carboic acid / Phenic acid	LT .14	UGG
108-95-2	/ Phenyllic acid / Phe*	LT .14	UGG
111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG
111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG
117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG
117-84-0	Di-n-octyl phthalate	LT .14	UGG
118-74-1	Hexachlorobenzene	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-LMLF7-6	SAIC01	0.0	16-MAY-97	UB	97U01650	SNV3/S	Anthracene	LT .14	UGG			
							120-12-7	1,2,4-Trichlorobenzene	LT .14	UGG			
							120-82-1	2,4-Dichlorophenol	LT .14	UGG			
							120-83-2	2,4-Dinitrotoluene	LT .14	UGG			
							121-14-2	Benzo[def]phenanthrene / Pyrene	LT .14	UGG			
							129-00-0	Dimethyl phthalate	1.4 E -2	UGG JP			
							131-11-3	Dibenzofuran	LT .14	UGG			
							132-64-9		LT .14	UGG			

191-24-2	Benzo[ghi]perylene	LT .14	UGG
193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG
205-99-2	Benzo[b]fluoranthene / 3,4-Benzofluoranthene	LT .14	UGG
206-44-0	Fluoranthene	1.7 E -2	UGG JP
207-08-9	Benzo[k]fluoranthene	LT .14	UGG
208-96-8	Acenaphthylene	LT .14	UGG
218-01-9	Chrysene	LT .14	UGG
50-32-8	Benzo[a]pyrene	LT .14	UGG
51-28-5	2,4-Dinitrophenol	LT .14	UGG 2
53-70-3	Dibenz[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG
534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG
541-73-1	1,3-Dichlorobenzene	LT .14	UGG
56-55-3	Benzo[a]anthracene	LT .14	UGG
59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG
606-20-2	2,6-Dinitrotoluene	LT .14	UGG
621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG
65-85-0	Benzoic acid	2.5 E -2	UGG JP
67-72-1	Hexachloroethane	LT .14	UGG
77-47-4	Hexachlorocyclopentadiene	LT .14	UGG 2
78-59-1	Isophorone	LT .14	UGG
83-32-9	Acenaphthene	LT .14	UGG
84-66-2	Diethyl phthalate	LT .14	UGG
84-74-2	Di-n-butyl phthalate	LT .14	UGG
85-01-8	Phenanthrene	1.3 E -2	UGG JP
85-68-7	Butylbenzyl phthalate	LT .14	UGG
86-30-6	N-Nitrosodiphenylamine	LT .14	UGG
86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG
86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG
87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG
87-86-5	Pentachlorophenol	LT .14	UGG
88-06-2	2,4,6-Trichlorophenol	LT .14	UGG
88-74-4	2-Nitroaniline	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 184 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
-----------	---------	------------------	-------	-------------	---------------	------------------	---------------------	------------	----------------------	------------	----------------



Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMUF7-6	SAIC01	0.0	16-MAY-97	UB	97U01650	VMS4/S	75-00-3	Chloroethane	LT 1.0 E -2	UGG		
								75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG		
								75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG		
								75-15-0	Carbon disulfide	LT 1.0 E -2	UGG		
								75-25-2	Bromoform	LT 1.0 E -2	UGG		
								75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG		
								75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG		
								75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG		
								75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG		
								75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG		
								78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG		
								78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG		
								79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG		
								79-01-6	Trichloroethylene / Trichloroethene / Ethinyl trichloride / T*	LT 1.0 E -2	UGG		
								79-34-5	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG		
									Xylenes, total combined	LT 1.0 E -2	UGG		
									trans-1,3-Dichloropropene	LT 1.0 E -2	UGG		
SD-LMVR-1	SAIC01		0.0	16-MAY-97	ES	SNSA*695	HBG1/S	120-36-5	2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG	?	
								1918-00-9	Dichloroprop	LT 1.00 E -2	UGG	?	
								7085-19-0	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid (+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP *	LT .2	UGG	?	
								75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichlor*	LT 1.00 E -2	UGG	?	
								88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6--*	LT 1.00 E -2	UGG	?	
								93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
								93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG	?	
								94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolylo*	LT .2	UGG	?	
								94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG	?	
								94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG	?	
								118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

- 186 -

30-JAN-98

16:17:59

Final Documentation Appendix Report

Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Lab Anly. No.	Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMVR-1	SAIC01	0.0	16-MAY-97	UB	97U01651	EXL4/S	121-82-4	121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
									2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
									479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
									606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
									88-72-2	2-Nitrotoluene	LT .4	UGG		
									98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
									99-08-1	3-Nitrotoluene	LT .4	UGG		
									99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
									99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
									99-99-0	4-Nitrotoluene	LT .4	UGG		
										2-Amino-4,6-dinitrotoluene	LT .2	UGG		
										4-Amino-2,6-dinitrotoluene	LT .2	UGG		
										Arsenic	2.3	UGG		
										Lead	6.13	UGG		
										Antimony	LT .305	UGG		
										Selenium	LT .25	UGG		
										Thallium	LT .2	UGG		
										Mercury	LT .1	UGG		
										Aluminum	2460	UGG		
										Iron	8820	UGG		
										Magnesium	20800	UGG		
										Manganese	205	UGG		
										Molybdenum	1.41	UGG	J	
										Nickel	5.87	UGG		
										Potassium	488	UGG		
										Silver	LT .5	UGG	J	
										Sodium	320	UGG		
										Tin	LT 5	UGG	J	
										Barium	8.1	UGG	JP	
										Beryllium	.131	UGG	JP	
										Boron	8.94	UGG		
										Cadmium	LT .5	UGG		

7440-47-3 Chromium 7.34 UGG  
 7440-48-4 Cobalt 2.95 UGG  
 7440-50-8 Copper 11.9 UGG  
 7440-62-2 Vanadium 26.7 UGG  
 7440-66-6 Zinc 29.7 UGG  
 7440-70-2 Calcium 42800 UGG  
 PST2/S 1024-57-3 Heptachlor epoxide 3.40 E -4 UGG JP  
 1031-07-8 Endosulfan sulfate LT 1.00 E -3 UGG  
 1104-28-2 PCB 1221 LT 1.30 E -2 UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 187 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)

File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMVR-1	SAIC01	0.0	16-MAY-97	UB	97U01651	PST2/S	11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
								309-00-2	Aldrin	5.48 E -4	UGG JP		
								319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	8.48 E -4	UGG BJP		
								319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	4.77 E -4	UGG BJP		
								319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.47 E -3	UGG BU		
								33213-65-9	Endosulfan II / beta-Endosulfan	LT 1.00 E -3	UGG		
								50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	2.64 E -3	UGG C		
								5103-71-9	alpha-Chlordane	3.90 E -4	UGG JP	I	
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG		
								53494-70-5	Endrin ketone	LT 1.00 E -3	UGG		
								5566-34-7	gamma-Chlordane	4.03 E -4	UGG JP		
								58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc	7.77 E -4	UGG JP		
								60-57-1	Dieldrin	3.72 E -4	UGG JP		
								72-20-8	Endrin	4.81 E -4	UGG BJP		
								72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethylidene)	1.60 E -3	UGG JP		
								72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth	6.37 E -3	UGG C		



72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	1.43 E -3	UGG C
7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG
76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7a-tetrahydro-2H-pyran-2-one	3.13 E -4	UGG JP
8001-35-2	Toxaphene / Chlorinated camphene / Camphenchlor / Alltox / *	LT .1	UGG
959-98-8	Endosulfan I / alpha-Endosulfan	LT 1.00 E -3	UGG
100-01-6	4-Nitroaniline	LT .14	UGG
100-02-7	4-Nitrophenol	LT .14	UGG
100-51-6	Benzyl alcohol	LT .14	UGG
105-67-9	2,4-Dimethylphenol	LT .14	UGG
106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG
106-46-7	1,4-Dichlorobenzene	LT .14	UGG
106-47-8	4-Chloroaniline	LT .14	UGG
108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG
108-95-2			

\* - Analyte Description has been truncated. See Data Dictionary

- 188 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMVHR-1	SAIC01	0.0	16-MAY-97	UB	97U01651	SMV3/S	108-95-2	Phenol / Carbolic acid / Phenic acid / Phenyllic acid / Phe*	LT .14	UGG		
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG		
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG		
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG		
								117-84-0	Di-n-octyl phthalate	LT .14	UGG		
								118-74-1	Hexachlorobenzene	LT .14	UGG		
								120-12-7	Anthracene	LT .14	UGG		
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
								120-83-2	2,4-Dichlorophenol	LT .14	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG		
								129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG		
								131-11-3	Dimethyl phthalate	2.3 E -2	UGG JP		
								132-64-9	Dibenzofuran	LT .14	UGG		
								191-24-2	Benzo[ghi]perylene	LT .14	UGG		
								193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG		
								205-99-2	Benzo[b]fluoranthene / 3,4-Benzofluoranthene	LT .14	UGG		
								206-44-0	Fluoranthene	2.0 E -2	UGG JP		

207-08-9	Benzo[k]fluoranthene	LT .14	UGG
208-96-8	Acenaphthylene	LT .14	UGG
218-01-9	Chrysene	LT .14	UGG
50-32-8	Benzo[a]pyrene	LT .14	UGG
51-28-5	2,4-Dinitrophenol	LT .14	UGG 2
53-70-3	Dibenz[ah]anthracene / 1,2:5,6-	LT .14	UGG
	Dibenzanthracene		
534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-	LT .14	UGG
	dinitrophenol		
541-73-1	1,3-Dichlorobenzene	LT .14	UGG
56-55-3	Benzo[a]anthracene	LT .14	UGG
59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-	LT .14	UGG
	cresol / 4-Chloro-3-m*		
606-20-2	2,6-Dinitrotoluene	LT .14	UGG
621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG
65-85-0	Benzoic acid	LT .14	UGG
67-72-1	Hexachloroethane	LT .14	UGG
77-47-4	Hexachlorocyclopentadiene	LT .14	UGG 2
78-59-1	Isophorone	LT .14	UGG
83-32-9	Acenaphthene	LT .14	UGG
84-66-2	Diethyl phthalate	LT .14	UGG
84-74-2	Di-n-butyl phthalate	LT .14	UGG
85-01-8	Phenanthrene	LT .14	UGG
85-68-7	Butylbenzyl phthalate	1.8 E -2	UGG JP
86-30-6	N-Nitrosodiphenylamine	LT .14	UGG
		LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 189 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMVHR-1	SAIC01	0.0	16-MAY-97	UB	97U01651	SMV3/S	Fluorene / 9H-Fluorene	LT .14	UGG		
							86-73-7	Carbazole / 9H-Carbazole	LT .14	UGG		
							86-74-8	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG		
							87-68-3					
							87-86-5	Pentachlorophenol	LT .14	UGG		
							88-06-2	2,4,6-Trichlorophenol	LT .14	UGG		
							88-74-4	2-Nitroaniline	LT .14	UGG		
							88-75-5	2-Nitrophenol	LT .14	UGG		
							91-20-3	Naphthalene / Tar camphor	LT .14	UGG		
							91-57-6	2-Methylnaphthalene	LT .14	UGG		
							91-58-7	2-Chloronaphthalene	LT .14	UGG		

91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG
95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG
95-50-1	1,2-Dichlorobenzene	LT .14	UGG
95-57-8	2-Chlorophenol	LT .14	UGG
95-95-4	2,4,5-Trichlorophenol	LT .14	UGG
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG
99-09-2	3-Nitroaniline	LT .14	UGG
	4-Bromophenyl phenyl ether	LT .14	UGG
	4-Chlorophenyl phenyl ether	LT .14	UGG
VMS4/S 100-41-4	Ethylbenzene	LT 1.0 E -2	UGG
100-42-5	Styrene / Ethenylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG
10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG
107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG
108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG
108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG
108-88-3	Toluene	LT 1.0 E -2	UGG
108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG
110-75-8	2-Chloroethyl vinyl ether / 1,2-Chloroethoxyethene	LT 1.0 E -2	UGG
124-48-1	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG
127-18-4	Tetrachloroethylene / Tetrachloroethene / Perchloroethylen*	LT 1.0 E -2	UGG
156-59-2	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG
156-60-5	trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG
56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 190 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-LMVHR-1	SAIC01	0.0	16-MAY-97	UB	97U01651	VMS4/S	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG		
							67-64-1	Acetone	.3	UGG	B	
							67-66-3	Chloroform	LT 1.0 E -2	UGG		

SD-NORTH-1	SAIC01	0.0	16-MAY-97	ES	SNSA*688	HBG1/S	71-43-2	71-55-6	74-83-9	74-87-3	75-00-3	75-01-4	75-09-2	75-15-0	75-25-2	75-27-4	75-34-3	75-35-4	75-43-4	75-69-4	78-87-5	78-93-3	79-00-5	79-01-6	79-34-5	1918-00-9	7085-19-0	75-99-0	88-85-7	93-72-1	93-76-5	94-74-6			
							Benzene																												
							1,1,1-Trichloroethane																												
							Bromomethane																												
							Chloromethane																												
							Chloroethane																												
							Vinyl chloride / Chloroethene																												
							Methylene chloride / Dichloromethane																												
							Carbon disulfide																												
							Bromoform																												
							Bromodichloromethane																												
							1,1-Dichloroethane																												
							1,1-Dichloroethylene / 1,1-																												
							Dichloroethene																												
							Freon / Dichlorofluoromethane																												
							Trichlorofluoromethane																												
							1,2-Dichloropropane																												
							Methyl ethyl ketone / 2-Butanone																												
							1,1,2-Trichloroethane																												
							Trichloroethylene / Trichloroethene /																												
							Ethynyl trichloride / T*																												
							Tetrachloroethane / 1,1,2,2-																												
							Tetrachloroethane / Acetylene *																												
							Xylenes, total combined																												
							trans-1,3-Dichloropropene																												
							2-(2,4-Dichlorophenoxy)propionic acid																												
							Dichloroprop																												
							Dicamba / 2-Methoxy-3,6-																												
							dichlorobenzoic acid																												
							(+/-)-2-(4-Chloro-2-																												
							methylphenoxy)propionic acid / MCPP /																												
							*																												
							Dalapon / alpha, alpha-																												
							Dichloropropionic acid / 2,2-Dichlor*																												
							Dinoseb / 2,4-Dinitro-6-sec-																												
							butylphenol / 2-sec-Butyl-4,6-*																												
							245TP / Silvex / 2-(2,4,5-																												
							Trichlorophenoxy)propionic acid *																												
							245T / (2,4,5-Trichlorophenoxy)acetic																												
							acid / Trioxone / We*																												
							(4-Chloro-2-methylphenoxy)acetic acid																												
							/ (4-Chloro-o-tolyl)*																												

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Meth/Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-1	SAIC01	0.0	16-MAY-97	ES	SNSA*688	94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG		?
							94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG		?
					UB	97U01652	118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG		
							121-14-2	2,4-Dinitrotoluene	LT .1	UGG		
							121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
							2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
							479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
							606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
							88-72-2	2-Nitrotoluene	LT .4	UGG		
							98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
							99-08-1	3-Nitrotoluene	LT .4	UGG		
							99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
							99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
							99-99-0	4-Nitrotoluene	LT .4	UGG		
								2-Amino-4,6-dinitrotoluene	LT .2	UGG		
								4-Amino-2,6-dinitrotoluene	LT .2	UGG		
						GRS2/S	7440-38-2	Arsenic	2.63	UGG		
						GPB1/S	7439-92-1	Lead	10.2	UGG		
						GS32/S	7440-36-0	Antimony	LT .305	UGG		
						GS32/S	7782-49-2	Selenium	LT .25	UGG		
						GT12/S	7440-28-0	Thallium	LT .2	UGG		
						HGC1/S	7439-97-6	Mercury	LT .1	UGG		
						ICE3/S	7429-90-5	Aluminum	2370	UGG		
							7439-89-6	Iron	6820	UGG		
							7439-95-4	Magnesium	32600	UGG		
							7439-96-5	Manganese	220	UGG		
							7439-98-7	Molybdenum	LT 1	UGG		J
							7440-02-0	Nickel	4.58	UGG		
							7440-09-7	Potassium	497	UGG		
							7440-22-4	Silver	LT .5	UGG		J
							7440-23-5	Sodium	394	UGG		
							7440-31-5	Tin	LT 5	UGG		J
							7440-39-3	Barium	7.52	UGG		JP
							7440-41-7	Beryllium	.116	UGG		JP
							7440-42-8	Boron	11.3	UGG		
							7440-43-9	Cadmium	LT .5	UGG		
							7440-47-3	Chromium	5.55	UGG		
							7440-48-4	Cobalt	2.6	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

- 192 -

Final Documentation Appendix Report  
 Installation : Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-1	SAIC01	0.0	16-MAY-97	UB 97U01652	ICP3/S	7440-50-8	Copper	5.9	UGG		
							7440-62-2	Vanadium	18.1	UGG		
							7440-66-6	Zinc	37.1	UGG		
							7440-70-2	Calcium	69000	UGG		
						PST2/S	1024-57-3	Heptachlor epoxide	4.02 E -4	UGG JP		
							1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG		
							1104-28-2	PCB 1221	LT 1.30 E -2	UGG		
							11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
							11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
							11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
							12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
							12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
							309-00-2	Aldrin	5.59 E -4	UGG JP		
							319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	LT 1.00 E -3	UGG		
							319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	6.01 E -4	UGG BJP		
							319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.22 E -3	UGG BJP		
							33213-65-9	Endosulfan II / beta-Endosulfan	5.57 E -4	UGG JP		
							50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	6.70 E -4	UGG JP		
							5103-71-9	alpha-Chlordane	3.82 E -4	UGG JP	I	
							53469-21-9	PCB 1242	LT 1.30 E -2	UGG		
							53494-70-5	Endrin ketone	LT 1.00 E -3	UGG		
							5566-34-7	gamma-Chlordane	4.47 E -4	UGG JP		
							58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc*	7.37 E -4	UGG JP		
							60-57-1	Dieldrin	4.53 E -4	UGG JP		
							72-20-8	Endrin	5.06 E -4	UGG BJP		
							72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethylidene*	1.38 E -3	UGG JP		
							72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	1.73 E -3	UGG C		
							72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	7.32 E -4	UGG JP		
							7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG		
							76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetra*	3.15 E -4	UGG JP		

\* - Analyte Description has been truncated. See Data Dictionary

- 193 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-1	SAIC01	0.0	16-MAY-97	UB	97U01652	SMV3/S	100-51-6	Benzyl alcohol	LT .14	UGG		
								105-67-9	2,4-Dimethylphenol	LT .14	UGG		
								106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG		
								106-46-7	1,4-Dichlorobenzene	LT .14	UGG		
								106-47-8	4-Chloroaniline	LT .14	UGG		
								108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG		
								108-95-2	Phenol / Carboic acid / Phenic acid / Phenylc acid / Phe*	LT .14	UGG		
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG		
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG		
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG		
								117-84-0	Di-n-octyl phthalate	LT .14	UGG		
								118-74-1	Hexachlorobenzene	LT .14	UGG		
								120-12-7	Anthracene	LT .14	UGG		
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
								120-83-2	2,4-Dichlorophenol	LT .14	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG		
								129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG		
								131-11-3	Dimethyl phthalate	LT .14	UGG		
								132-64-9	Dibenzofuran	LT .14	UGG		
								191-24-2	Benzo[ghi]perylene	LT .14	UGG		
								193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG		
								205-99-2	Benzo[b]fluoranthene / 3,4-Benzofluoranthene	LT .14	UGG		
								206-44-0	Fluoranthene	LT .14	UGG		
								207-08-9	Benzo[k]fluoranthene	LT .14	UGG		
								208-96-8	Acenaphthylene	LT .14	UGG		
								218-01-9	Chrysene	LT .14	UGG		
								50-32-8	Benzo[a]pyrene	LT .14	UGG		
								51-28-5	2,4-Dinitrophenol	LT .14	UGG		
								53-70-3	Dibenz[ah]anthracene / 1,2:5,6-	LT .14	UGG		

2

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

- 194 -

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-1	SAIC01	0.0	16-MAY-97	UB	97U01652	SW3/S	83-32-9	Acenaphthene	LT .14	UGG		
								84-66-2	Diethyl phthalate	LT .14	UGG		
								84-74-2	Di-n-butyl phthalate	LT .14	UGG		
								85-01-8	Phenanthrene	LT .14	UGG		
								85-68-7	Butylbenzyl phthalate	LT .14	UGG		
								86-30-6	N-Nitrosodiphenylamine	LT .14	UGG		
								86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG		
								86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG		
								87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG		
								87-86-5	Pentachlorophenol	LT .14	UGG		
								88-06-2	2,4,6-Trichlorophenol	LT .14	UGG		
								88-74-4	2-Nitroaniline	LT .14	UGG		
								88-75-5	2-Nitrophenol	LT .14	UGG		
								91-20-3	Naphthalene / Tar camphor	LT .14	UGG		
								91-57-6	2-Methylnaphthalene	LT .14	UGG		
								91-58-7	2-Chloronaphthalene	LT .14	UGG		
								91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG		
								95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG		
								95-50-1	1,2-Dichlorobenzene	LT .14	UGG		
								95-57-8	2-Chlorophenol	LT .14	UGG		
								95-95-4	2,4,5-Trichlorophenol	LT .14	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane /	LT .14	UGG		





75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG	
75-09-2	Methylene chloride / Dichloromethane	6.0 E -4	UGG	JP
75-15-0	Carbon disulfide	LT 1.0 E -2	UGG	
75-25-2	Bromoform	LT 1.0 E -2	UGG	
75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG	
75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG	
75-35-4	1,1-Bichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG	
75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG	
75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG	
78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG	
78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG	
79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG	
79-01-6	Trichloroethylene / Trichloroethene / Ethinyl trichloride / T*	LT 1.0 E -2	UGG	
79-34-5	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG	
	Xylenes, total combined	LT 1.0 E -2	UGG	
	trans-1,3-Dichloropropene	LT 1.0 E -2	UGG	
	2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG	?
	Dichloroprop			
1918-00-9	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG	?
7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP / *	LT .2	UGG	?
75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichlor*	LT 1.00 E -2	UGG	?
88-85-7				

\* - Analyte Description has been truncated. See Data Dictionary

- 196 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-2	SAIC01	0.0	16-MAY-97	ES	SNSA*691	HBG1/S	88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-+ 245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
								93-72-1	Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
								93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG	?	
								94-74-6	(4-Chloro-2-methylphenoxy)acetic acid	LT .2	UGG	?	

94-75-7	/ (4-Chloro-o-tolyl) <sup>*</sup>	LT 1.00 E -2	UGG	?
94-82-6	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG	?
118-96-7	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT .2	UGG	
121-14-2	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .1	UGG	
121-82-4	2,4-Dinitrotoluene	LT .2	UGG	
2691-41-0	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG	
479-45-8	Cyclotetramethylenetetranitramine	LT .2	UGG	
606-20-2	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG	
88-72-2	2,6-Dinitrotoluene	LT .4	UGG	
98-95-3	2-Nitrotoluene	LT .2	UGG	
99-08-1	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .4	UGG	
99-35-4	3-Nitrotoluene	LT .1	UGG	
99-65-0	1,3,5-Trinitrobenzene	LT .1	UGG	
99-99-0	1,3-Dinitrobenzene	LT .4	UGG	
	4-Nitrotoluene	LT .2	UGG	
	2-Amino-4,6-dinitrotoluene	LT .2	UGG	
	4-Amino-2,6-dinitrotoluene	2.48	UGG	
	Arsenic	5.71	UGG	
	Lead	LT .305	UGG	
	Antimony	LT .25	UGG	
	Selenium	LT .2	UGG	
	Thallium	LT .1	UGG	
	Mercury	2540	UGG	
	Aluminum	6890	UGG	
	Iron	20400	UGG	
	Magnesium	248	UGG	
	Manganese	1.38	UGG	J
	Molybdenum	5.77	UGG	
	Nickel	570	UGG	
	Potassium	LT .5	UGG	J
	Silver			

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
-----------	---------	------------------	-------	-------------	---------------	------------------	---------	---------------------	------------	----------------------	------------	----------------



30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-2	SAIC01	0.0	16-MAY-97	UB	97U01653	PS72/S	7421-93-4 76-44-8	Endrin aldehyde Heptachlor / 1H-1,4,5,6,7,8,8- Heptachloro-3a,4,7,7a-tetra <sup>+</sup> Toxaphene / Chlorinated camphene / Camphechlor / Alltox / *	LT 1.00 E -3 4.41 E -4	UGG JP		
								8001-35-2	Endosulfan I / alpha-Endosulfan	LT .1	UGG		
							SMV3/S	959-98-8	4-Nitroaniline	LT 1.00 E -3	UGG		
								100-01-6	4-Nitrophenol	LT .14	UGG		
								100-02-7	Benzyl alcohol	LT .14	UGG		
								100-51-6	2,4-Dimethylphenol	LT .14	UGG		
								105-67-9	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG		
								106-44-5	1,4-Dichlorobenzene	LT .14	UGG		
								106-46-7	4-Chloroaniline	LT .14	UGG		
								106-47-8	Bis(2-chloroisopropyl) ether	LT .14	UGG		
								108-60-1	Phenol / Carboic acid / Phenic acid	LT .14	UGG		
								108-95-2	/ Phenyllic acid / Phe <sup>+</sup>	LT .14	UGG		
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG		
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG		
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG		
								117-84-0	Di-n-octyl phthalate	LT .14	UGG		
								118-74-1	Hexachlorobenzene	LT .14	UGG		
								120-12-7	Anthracene	LT .14	UGG		
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
								120-83-2	2,4-Dichlorophenol	LT .14	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG		
								129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG		
								131-11-3	Dimethyl phthalate	LT .14	UGG		
								132-64-9	Dibenzofuran	LT .14	UGG		
								191-24-2	Benzo[ghi]perylene	LT .14	UGG		
								193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG		
								205-99-2	Benzo[b]fluoranthene / 3,4- Benzofluoranthene	LT .14	UGG		
								206-44-0	Fluoranthene	LT .14	UGG		
								207-08-9	Benzo[k]fluoranthene	LT .14	UGG		
								208-96-8	Acenaphthylene	LT .14	UGG		
								218-01-9	Chrysene	LT .14	UGG		
								50-32-8	Benzo[a]pyrene	LT .14	UGG		
								51-28-5	2,4-Dinitrophenol	LT .14	UGG		
								53-70-3	Dibenz[ah]anthracene / 1,2:5,6- Dibenzanthracene	LT .14	UGG 2		
								534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6- dinitrophenol	LT .14	UGG		
								541-73-1	1,3-Dichlorobenzene	LT .14	UGG		

30-JAN-98

16:17:59

- 199 -

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-2	SAIC01	0.0	16-MAY-97	UB	97U01653	SNV3/S	59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .14	UGG		
								621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG		
								65-85-0	Benzoic acid	3.2 E -2	UGG JP		
								67-72-1	Hexachloroethane	LT .14	UGG		
								77-47-4	Hexachlorocyclopentadiene	LT .14	UGG 2		
								78-59-1	Isophorone	LT .14	UGG		
								83-32-9	Acenaphthene	LT .14	UGG		
								84-66-2	Diethyl phthalate	LT .14	UGG		
								84-74-2	Di-n-butyl phthalate	LT .14	UGG		
								85-01-8	Phenanthrene	1.7 E -2	UGG JP		
								85-68-7	Butylbenzyl phthalate	LT .14	UGG		
								86-30-6	N-Nitrosodiphenylamine	LT .14	UGG		
								86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG		
								86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG		
								87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG		
								87-86-5	Pentachlorophenol	LT .14	UGG		
								88-06-2	2,4,6-Trichlorophenol	LT .14	UGG		
								88-74-4	2-Nitroaniline	LT .14	UGG		
								88-75-5	2-Nitrophenol	LT .14	UGG		
								91-20-3	Naphthalene / Tar camphor	LT .14	UGG		
								91-57-6	2-Methylnaphthalene	LT .14	UGG		
								91-58-7	2-Chloronaphthalene	LT .14	UGG		
								91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG		
								95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG		
								95-50-1	1,2-Dichlorobenzene	LT .14	UGG		
								95-57-8	2-Chlorophenol	LT .14	UGG		
								95-95-4	2,4,5-Trichlorophenol	LT .14	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG		
								99-09-2	3-Nitroaniline	LT .14	UGG		
									4-Bromophenyl phenyl ether	LT .14	UGG		
									4-Chlorophenyl phenyl ether	LT .14	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

- 200 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE 30-JAN-98  
Sampling Date Range: 01-SEP-96

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-2	SAIC01	0.0	16-MAY-97	UB	97U01653	VMS4/S	108-10-1	Methyl isobutyl ketone / isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGS		
								108-88-3	Toluene	LT 1.0 E -2	UGS		
								108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGS		
								110-75-8	2-Chloroethyl vinyl ether / 12-Chloroethoxyethene	LT 1.0 E -2	UGS		
								124-48-1	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGS		
								127-18-4	Tetrachloroethylene / Tetrachloroethene / Perchloroethylen*	LT 1.0 E -2	UGS		
								156-59-2	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGS		
								156-60-5	trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGS		
								56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGS		
								591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGS		
								67-64-1	Acetone	5.4 E -2	UGS B		
								67-66-3	Chloroform	LT 1.0 E -2	UGS		
								71-43-2	Benzene	LT 1.0 E -2	UGS		
								71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGS		
								74-83-9	Bromomethane	LT 1.0 E -2	UGS		
								74-87-3	Chloromethane	LT 1.0 E -2	UGS		
								75-00-3	Chloroethane	LT 1.0 E -2	UGS		
								75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGS		
								75-09-2	Methylene chloride / Dichloromethane	5.3 E -4	UGS JP		
								75-15-0	Carbon disulfide	LT 1.0 E -2	UGS		
								75-25-2	Bromoform	LT 1.0 E -2	UGS		
								100-41-4	Ethylbenzene	LT 1.0 E -2	UGS		
								100-42-5	Styrene / Ethenylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGS		
								10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGS		
								107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGS		
								108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGS		
								108-10-1					

75-27-4 Bromodichloromethane LT 1.0 E -2 UGG  
 75-34-3 1,1-Dichloroethane LT 1.0 E -2 UGG  
 75-35-4 1,1-Dichloroethylene / 1,1-Dichloroethene LT 1.0 E -2 UGG  
 75-43-4 Freon / Dichlorofluoromethane LT 1.0 E -2 UGG  
 75-69-4 Trichlorofluoromethane LT 1.0 E -2 UGG  
 78-87-5 1,2-Dichloropropane LT 1.0 E -2 UGG  
 78-93-3 Methyl ethyl ketone / 2-Butanone LT 1.0 E -2 UGG  
 79-00-5 1,1,2-Trichloroethane LT 1.0 E -2 UGG  
 79-01-6 Trichloroethylene /Trichloroethene / Ethinyl trichloride /T\* LT 1.0 E -2 UGG  
 79-34-5 Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene \* LT 1.0 E -2 UGG  
 Xylenes, total combined LT 1.0 E -2 UGG  
 trans-1,3-Dichloropropene LT 1.0 E -2 UGG  
 2-(2,4-Dichlorophenoxy)propionic acid LT 1.00 E -2 ?  
 Dichloroprop

SD-NORTH-3 SAIC01 0.0 16-MAY-97 ES SNSA\*689 HBGI/S 120-36-5

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-3	SAIC01	0.0	16-MAY-97	ES	SNSA*689	HBGI/S	1918-00-9	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG	?	
								7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP / *	LT .2	UGG	?	
								75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichlor*	LT 1.00 E -2	UGG	?	
								88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG	?	
								93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
								93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG	?	
								94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolylo*	LT .2	UGG	?	
								94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG	?	
								94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG	?	



UB	97U01654	EXL4/S	118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG
			121-14-2	2,4-Dinitrotoluene	LT .1	UGG
			121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG
			2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG
			479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG
			606-20-2	2,6-Dinitrotoluene	LT .2	UGG
			88-72-2	2-Nitrotoluene	LT .4	UGG
			98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG
			99-08-1	3-Nitrotoluene	LT .4	UGG
			99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG
			99-65-0	1,3-Dinitrobenzene	LT .1	UGG
			99-99-0	4-Nitrotoluene	LT .4	UGG
				2-Amino-4,6-dinitrotoluene	LT .2	UGG
				4-Amino-2,6-dinitrotoluene	LT .2	UGG
				Arsenic	3	UGG
				Lead	6.24	UGG
				Antimony	LT .305	UGG
				Selenium	LT .25	UGG
				Thallium	LT .2	UGG
				Mercury	LT .1	UGG
				Aluminum	2630	UGG

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-3	SAIC01	0.0	16-MAY-97	UB	97U01654	ICP3/S	7439-89-6	Iron	6420	UGG			
								7439-95-4	Magnesium	20600	UGG			
								7439-96-5	Manganese	225	UGG		J	
								7439-98-7	Molybdenum	2.21	UGG			
								7440-02-0	Nickel	5.79	UGG			
								7440-09-7	Potassium	662	UGG			
								7440-22-4	Silver	LT .5	UGG		J	
								7440-23-5	Sodium	348	UGG			
								7440-31-5	Tin	LT 5	UGG		J	
								7440-39-3	Barium	9.14	UGG	JP		
								7440-41-7	Beryllium	.112	UGG	JP		

7440-42-8	Boron	8.53	UGG
7440-43-9	Cadmium	LT .5	UGG
7440-47-3	Chromium	5.89	UGG
7440-48-4	Cobalt	2.34	UGG JP
7440-50-8	Copper	5.53	UGG
7440-62-2	Vanadium	12.7	UGG
7440-66-6	Zinc	27.2	UGG
7440-70-2	Calcium	44000	UGG
PST2/S 1024-57-3	Heptachlor epoxide	3.03 E -4	UGG JP
1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG
1104-28-2	PCB 1221	LT 1.30 E -2	UGG
11096-82-5	PCB 1260	LT 1.30 E -2	UGG
11097-69-1	PCB 1254	LT 1.30 E -2	UGG
11141-16-5	PCB 1232	LT 1.30 E -2	UGG
12672-29-6	PCB 1248	LT 1.30 E -2	UGG
12674-11-2	PCB 1016	LT 1.30 E -2	UGG
309-00-2	Aldrin	6.80 E -4	UGG JP
319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	9.42 E -4	UGG BJP
319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	8.43 E -4	UGG BJP
319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.21 E -3	UGG BU
33213-65-9	Endosulfan II / beta-Endosulfan	2.79 E -4	UGG JP
50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	1.24 E -3	UGG C
5103-71-9	alpha-Chlordane	4.34 E -4	UGG JP I
53469-21-9	PCB 1242	LT 1.30 E -2	UGG
53494-70-5	Endrin ketone	3.64 E -4	UGG JP
5566-34-7	gamma-Chlordane	4.58 E -4	UGG JP
58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc	8.95 E -4	UGG JP
60-57-1	Dieldrin	4.10 E -4	UGG JP

\* - Analyte Description has been truncated. See Data Dictionary

- 203 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-3	SAIC01	0.0	16-MAY-97	97U01654	UB	PST2/S	72-20-8	Endrin	5.17 E -4	UGG BJP		
								72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethylidene)	1.53 E -3	UGG JP		

72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	2.19 E -3	UGG C
72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	8.35 E -4	UGG JP
7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG
76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetra*	4.78 E -4	UGG JP
8001-35-2	Toxaphene / Chlorinated camphene / Campechlor / Alltox / *	LT .1	UGG
959-98-8	Endosulfan I / alpha-Endosulfan	3.54 E -4	UGG JP
100-01-6	4-Nitroaniline	LT .14	UGG
100-02-7	4-Nitrophenol	LT .14	UGG
100-51-6	Benzyl alcohol	LT .14	UGG
105-67-9	2,4-Dimethylphenol	LT .14	UGG
106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG
106-46-7	1,4-Dichlorobenzene	LT .14	UGG
106-47-8	4-Chloroaniline	LT .14	UGG
108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG
108-95-2	Phenol / Carboic acid / Phenic acid / Phenyl acid / Phe*	LT .14	UGG
111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG
111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG
117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG
117-84-0	Di-n-octyl phthalate	LT .14	UGG
118-74-1	Hexachlorobenzene	LT .14	UGG
120-12-7	Anthracene	LT .14	UGG
120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG
120-83-2	2,4-Dichlorophenol	LT .14	UGG
121-14-2	2,4-Dinitrotoluene	LT .14	UGG
129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG
131-11-3	Dimethyl phthalate	LT .14	UGG
132-64-9	Dibenzofuran	LT .14	UGG
191-24-2	Benzo[ghi]perylene	LT .14	UGG
193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG
205-99-2	Benzo[b]fluoranthene / 3,4-Benzofluoranthene	LT .14	UGG
206-44-0	Fluoranthene	LT .14	UGG
207-08-9	Benzo[k]fluoranthene	LT .14	UGG
208-96-8	Acenaphthylene	LT .14	UGG
218-01-9	Chrysene	LT .14	UGG
50-32-8	Benzo[a]pyrene	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-3	SAIC01	0.0	16-MAY-97	UB	97U01654	SMV3/S	51-28-5	2,4-Dinitrophenol	LT .14	UGG 2		
								53-70-3	Dibenz[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG		
								534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG		
								541-73-1	1,3-Dichlorobenzene	LT .14	UGG		
								56-55-3	Benzo[a]anthracene	LT .14	UGG		
								59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .14	UGG		
								621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG		
								65-85-0	Benzoic acid	2.7 E -2	UGG JP		
								67-72-1	Hexachloroethane	LT .14	UGG		
								77-47-4	Hexachlorocyclopentadiene	LT .14	UGG 2		
								78-59-1	Isophorone	LT .14	UGG		
								83-32-9	Acenaphthene	LT .14	UGG		
								84-66-2	Diethyl phthalate	LT .14	UGG		
								84-74-2	Di-n-butyl phthalate	LT .14	UGG		
								85-01-8	Phenanthrene	LT .14	UGG		
								85-68-7	Butylbenzyl phthalate	1.7 E -2	UGG JP		
								86-30-6	N-Nitrosodiphenylamine	LT .14	UGG		
								86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG		
								86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG		
								87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG		
								87-86-5	Pentachlorophenol	LT .14	UGG		
								88-06-2	2,4,6-Trichlorophenol	LT .14	UGG		
								88-74-4	2-Nitroaniline	LT .14	UGG		
								88-75-5	2-Nitrophenol	LT .14	UGG		
								91-20-3	Naphthalene / Tar camphor	LT .14	UGG		
								91-57-6	2-Methylnaphthalene	LT .14	UGG		
								91-58-7	2-Chloronaphthalene	LT .14	UGG		
								91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG		
								95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG		
								95-50-1	1,2-Dichlorobenzene	LT .14	UGG		
								95-57-8	2-Chlorophenol	LT .14	UGG		
								95-95-4	2,4,5-Trichlorophenol	LT .14	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG		
								99-09-2	3-Nitroaniline	LT .14	UGG		
									4-Bromophenyl phenyl ether	LT .14	UGG		
									4-Chlorophenyl phenyl ether	LT .14	UGG		
									Ethylbenzene	LT 1.0 E -2	UGG		

VMS4/S 100-41-4  
100-42-5

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab. No.	Lab. Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-3	SAIC01	0.0	16-MAY-97	UB	97U01654	WMS4/S	100-42-5	Styrene / Ethenylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG		
								10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG		
								107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG		
								108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG		
								108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG		
								108-88-3	Toluene	LT 1.0 E -2	UGG		
								108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG		
								110-75-8	2-Chloroethyl vinyl ether / (2-Chloroethoxy)ethene	LT 1.0 E -2	UGG		
								124-48-1	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG		
								127-18-4	Tetrachloroethylene / Tetrachloroethene / Perchloroethylen*	LT 1.0 E -2	UGG		
								156-59-2	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG		
								156-60-5	trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG		
								56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG		
								591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG		
								67-64-1	Acetone	2.6 E -2	UGG B		
								67-66-3	Chloroform	LT 1.0 E -2	UGG		
								71-43-2	Benzene	LT 1.0 E -2	UGG		
								71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG		
								74-83-9	Bromomethane	LT 1.0 E -2	UGG		
								74-87-3	Chloromethane	LT 1.0 E -2	UGG		
								75-00-3	Chloroethane	LT 1.0 E -2	UGG		
								75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG		
								75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG		
								75-15-0	Carbon disulfide	LT 1.0 E -2	UGG		
								75-25-2	Bromoform	LT 1.0 E -2	UGG		
								75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG		
								75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG		
								75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG		
								75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

- 206 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-3	SAIC01	0.0	16-MAY-97	UB	97U01654	VMS4/S	79-01-6	Trichloroethylene /Trichloroethene / Ethinyl trichloride /T*	LT 1.0 E -2	UGG		
									Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG		
									Xylenes, total combined	LT 1.0 E -2	UGG		
									trans-1,3-Dichloropropene	LT 1.0 E -2	UGG		
									2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG		
SD-NORTH-4	SAIC01	0.0	16-MAY-97	UB	97U01655	EXL4/S	118-96-7	121-14-2	2,4-Dinitrotoluene	LT .1	UGG		
								121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
								2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
								479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
								88-72-2	2-Nitrotoluene	LT .4	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
								99-08-1	3-Nitrotoluene	LT .4	UGG		
								99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
								99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
								99-99-0	4-Nitrotoluene	LT .4	UGG		
									2-Amino-4,6-dinitrotoluene	LT .2	UGG		
									4-Amino-2,6-dinitrotoluene	LT .2	UGG		
									Arsenic	2.99	UGG		
									Lead	10.1	UGG		
								7440-38-2	Antimony	LT .305	UGG		
								7439-92-1	Selenium	LT .25	UGG		
								7440-36-0	Thallium	LT .2	UGG		
								7782-49-2	Mercury	LT .1	UGG		
								7440-28-0	Aluminum	2690	UGG		

7439-89-6	Iron	7240	UGG
7439-95-4	Magnesium	29100	UGG
7439-96-5	Manganese	220	UGG
7439-98-7	Molybdenum	LT 1	UGG J
7440-02-0	Nickel	5.29	UGG
7440-09-7	Potassium	543	UGG
7440-22-4	Silver	LT .5	UGG J
7440-23-5	Sodium	424	UGG
7440-31-5	Tin	LT 5	UGG J
7440-39-3	Barium	8.12	UGG JP
7440-41-7	Beryllium	.108	UGG JP
7440-42-8	Boron	10.4	UGG
7440-43-9	Cadmium	LT .5	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 207 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-4	SAIC01	0.0	16-MAY-97	UB	97U01655	ICP3/S	7440-47-3	Chromium	6.62	UGG		
								7440-48-4	Cobalt	2.43	UGG JP		
								7440-50-8	Copper	3.89	UGG		
								7440-62-2	Vanadium	19	UGG		
								7440-66-6	Zinc	46.9	UGG		
								7440-70-2	Calcium	60700	UGG		
							PST2/S	1024-57-3	Heptachlor epoxide	3.71 E -4	UGG JP		
								1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG		
								1104-28-2	PCB 1221	LT 1.30 E -2	UGG		
								11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
								309-00-2	Aldrin	5.53 E -4	UGG JP		
								319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	9.39 E -4	UGG BJP		
								319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	6.35 E -4	UGG BJP		
								319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	9.20 E -4	UGG BJP		
								33213-65-9	Endosulfan II / beta-Endosulfan	5.53 E -4	UGG JP		
								50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-	5.88 E -4	UGG JP		





120-12-7	Anthracene	LT .14	UGG
120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG
120-83-2	2,4-Dichlorophenol	LT .14	UGG
121-14-2	2,4-Dinitrotoluene	LT .14	UGG
129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG
131-11-3	Dimethyl phthalate	LT .14	UGG
132-64-9	Dibenzofuran	LT .14	UGG
191-24-2	Benzo[ghi]perylene	LT .14	UGG
193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG
205-99-2	Benzo[b]fluoranthene / 3,4-Benzofluoranthene	LT .14	UGG
206-44-0	Fluoranthene	LT .14	UGG
207-08-9	Benzo[k]fluoranthene	LT .14	UGG
208-96-8	Acenaphthylene	LT .14	UGG
218-01-9	Chrysene	LT .14	UGG
50-32-8	Benzo[a]pyrene	LT .14	UGG
51-28-5	2,4-Dinitrophenol	LT .14	UGG 2
53-70-3	Dibenz[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG
534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG
541-73-1	1,3-Dichlorobenzene	LT .14	UGG
56-55-3	Benzo[a]anthracene	LT .14	UGG
59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG
606-20-2	2,6-Dinitrotoluene	LT .14	UGG
621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG
65-85-0	Benzoic acid	2.9 E -2	UGG JP
67-72-1	Hexachloroethane	LT .14	UGG

- 209 -

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-4	SAIC01	0.0	16-MAY-97	UB	97U01655	77-47-4	Hexachlorocyclopentadiene	LT .14	UGG 2		
							78-59-1	Isophorone	LT .14	UGG		
							83-32-9	Acenaphthene	LT .14	UGG		
							84-66-2	Diethyl phthalate	LT .14	UGG		
							84-74-2	Di-n-butyl phthalate	LT .14	UGG		
							85-01-8	Phenanthrene	LT .14	UGG		
							85-68-7	Butylbenzyl phthalate	LT .14	UGG		

86-30-6	N-Nitrosodiphenylamine	LT .14	UGG
86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG
86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG
87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG
87-86-5	Pentachlorophenol	LT .14	UGG
88-06-2	2,4,6-Trichlorophenol	LT .14	UGG
88-74-4	2-Nitroaniline	LT .14	UGG
88-75-5	2-Nitrophenol	LT .14	UGG
91-20-3	Naphthalene / Tar camphor	LT .14	UGG
91-57-6	2-Methylnaphthalene	LT .14	UGG
91-58-7	2-Chloronaphthalene	LT .14	UGG
91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG
95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG
95-50-1	1,2-Dichlorobenzene	LT .14	UGG
95-57-8	2-Chlorophenol	LT .14	UGG
95-95-4	2,4,5-Trichlorophenol	LT .14	UGG
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG
99-09-2	3-Nitroaniline	LT .14	UGG
	4-Bromophenyl phenyl ether	LT .14	UGG
	4-Chlorophenyl phenyl ether	LT .14	UGG
VMS4/S 100-41-4	Ethylbenzene	LT 1.0 E -2	UGG
100-42-5	Styrene / Ethylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG
10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG
107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG
108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG
108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG
108-88-3	Toluene	LT 1.0 E -2	UGG
108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG
110-75-8	2-Chloroethyl vinyl ether / (2-Chloroethoxy)ethene	LT 1.0 E -2	UGG
124-48-1			

\* - Analyte Description has been truncated. See Data Dictionary

- 210 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo	Conc	Unit Flag	Meas Codes	Data Quals	EPA Data Quals
-----------	---------	------------------	-------	-------------	---------------	------------------	---------	---------------------	-------	------	-----------	------------	------------	----------------



Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-5	SAIC01	0.0	16-MAY-97	ES	SNSA*690	HBG1/S	75-99-0	Dalapon / alpha, alpha-Dichloropropionic acid / 2,2-Dichloro-Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6--245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
								88-85-7	butylphenol / 2-sec-Butyl-4,6--245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
								93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG	?	
								93-76-5	245TP / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG	?	
								94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolyl)*	LT .2	UGG	?	
								94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG	?	
								94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG	?	
					UB	37U01656	EXL4/S	118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .1	UGG		
								121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
								2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
								479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
								88-72-2	2-Nitrotoluene	LT .4	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
								99-08-1	3-Nitrotoluene	LT .4	UGG		
								99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
								99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
								99-99-0	4-Nitrotoluene	LT .4	UGG		
									2-Amino-4,6-dinitrotoluene	LT .2	UGG		
									4-Amino-2,6-dinitrotoluene	LT .2	UGG		
									Arsenic	2.78	UGG		
									Lead	11.8	UGG		
									Antimony	LT .305	UGG		
									Selenium	LT .25	UGG		
									Thallium	LT .2	UGG		
									Mercury	LT .1	UGG		
									Aluminum	2120	UGG		
									Iron	7600	UGG		
									Magnesium	36500	UGG		
									Manganese	237	UGG		
									Molybdenum	LT 1	UGG		J

\* - Analyte Description has been truncated. See Data Dictionary

7440-02-0 Nickel

5.01

UGG

- 212 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-5	SAIC01	0.0	16-MAY-97	UB	97U01656	ICP3/S	7440-09-7	Potassium	463	UGG		
								7440-22-4	Silver	LT .5	UGG	J	
								7440-23-5	Sodium	399	UGG		
								7440-31-5	Tin	LT 5	UGG	J	
								7440-39-3	Barium	9.77	UGG JP		
								7440-41-7	Beryllium	6.52 E -2	UGG JP		
								7440-42-8	Boron	4.59	UGG JP		
								7440-43-9	Cadmium	.749	UGG		
								7440-47-3	Chromium	5.61	UGG		
								7440-48-4	Cobalt	2.7	UGG		
								7440-50-8	Copper	5.58	UGG		
								7440-62-2	Vanadium	23	UGG		
								7440-66-6	Zinc	52.3	UGG		
								7440-70-2	Calcium	77000	UGG		
							PST2/S	1024-57-3	Heptachlor epoxide	3.67 E -4	UGG JP		
								1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG		
								1104-28-2	PCB 1221	LT 1.30 E -2	UGG		
								11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
								309-00-2	Aldrin	5.77 E -4	UGG JP		
								319-84-6	alpha-Hexachlorocyclohexane / alpha-hexachlorocyclohexane	LT 1.00 E -3	UGG		
								319-85-7	Beta-hexachlorocyclohexane / beta-hexachlorocyclohexane	5.70 E -4	UGG BJP		
								319-86-8	delta-Hexachlorocyclohexane / delta-hexachlorocyclohexane	1.25 E -3	UGG BU		
								33213-65-9	Benzene hexachloride				
								50-29-3	Endosulfan II / beta-Endosulfan	LT 1.00 E -3	UGG		
									2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	7.71 E -4	UGG JP		
								5103-71-9	alpha-Chlordane	3.28 E -4	UGG JP	I	
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG		
								53494-70-5	Endrin ketone	LT 1.00 E -3	UGG		

5566-34-7 gamma-Chlordane  
 58-89-9 Lindane / gamma-Benzene hexachloride  
           / gamma-Hexachlorocyc\*  
 60-57-1 Dieldrin  
 72-20-8 Endrin  
 72-43-5 Methoxychlor / Methoxy-DDT / 1,1'-  
           (2,2,2-Trichloroethylidene\*  
 72-54-8 ppDDD / 1,1-Dichloro-2,2-bis(p-  
           chlorophenyl)ethane / Rhoth\*

3.57 E -4 UGG JP  
 7.23 E -4 UGG JP  
 3.93 E -4 UGG JP  
 4.84 E -4 UGG BJP  
 1.63 E -3 UGG JP  
 1.41 E -3 UGG C

\* - Analyte Description has been truncated. See Data Dictionary

- 213 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation : Fort Sheridan, IL (SN)

File Type: CSE 30-JAN-98  
 Sampling Date Range: 01-SEP-96

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Matrix	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-5	SAIC01	0.0	16-MAY-97	UB	97U01656	PST2/S	72-55-9	2,2-Bis(p-chlorophenyl)-1,1- dichloroethene	7.22 E -4	UGG JP		
								7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG		
								76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8- Heptachloro-3a,4,7,7a-tetra*	3.36 E -4	UGG JP		
								8001-35-2	Toxaphene / Chlorinated camphene / Campechlor / Alltox / *	LT .1	UGG		
								959-98-8	Endosulfan I / alpha-Endosulfan	LT 1.00 E -3	UGG		
							SHV3/S	100-01-6	4-Nitroaniline	LT .14	UGG		
								100-02-7	4-Nitrophenol	LT .14	UGG		
								100-51-6	Benzyl alcohol	LT .14	UGG		
								105-67-9	2,4-Dimethylphenol	LT .14	UGG		
								106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG		
								106-46-7	1,4-Dichlorobenzene	LT .14	UGG		
								106-47-8	4-Chloroaniline	LT .14	UGG		
								108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG		
								108-95-2	Phenol / Carboic acid / Phenic acid / Phenylc acid / Phe*	LT .14	UGG		
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG		
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG		
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG		
								117-84-0	Di-n-octyl phthalate	LT .14	UGG		
								118-74-1	Hexachlorobenzene	LT .14	UGG		
								120-12-7	Anthracene	LT .14	UGG		
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
								120-83-2	2,4-Dichlorophenol	LT .14	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG		

129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG
131-11-3	Dimethyl phthalate	LT .14	UGG
132-64-9	Dibenzofuran	LT .14	UGG
191-24-2	Benzo[ghi]perylene	LT .14	UGG
193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG
205-99-2	Benzo[b]fluoranthene / 3,4-	LT .14	UGG
	Benzo[fluoranthene		
206-44-0	Fluoranthene	LT .14	UGG
207-08-9	Benzo[k]fluoranthene	LT .14	UGG
208-96-8	Acenaphthylene	LT .14	UGG
218-01-9	Chrysene	LT .14	UGG
50-32-8	Benzo[a]pyrene	LT .14	UGG
51-28-5	2,4-Dinitrophenol	LT .14	UGG 2
53-70-3	Dibenz[ah]anthracene / 1,2:5,6-	LT .14	UGG
	Dibenzanthracene		
534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-	LT .14	UGG
	dinitrophenol		

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-5	SAIC01	0.0	16-MAY-97	UB	97U01656	SMV3/S							
								541-73-1	1,3-Dichlorobenzene	LT .14	UGG			
								56-55-3	Benzo[a]anthracene	LT .14	UGG			
								59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG			
								606-20-2	2,6-Dinitrotoluene	LT .14	UGG			
								621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG			
								65-85-0	Benzoic acid	LT .14	UGG			
								67-72-1	Hexachloroethane	LT .14	UGG			
								77-47-4	Hexachlorocyclopentadiene	LT .14	UGG 2			
								78-59-1	Isophorone	LT .14	UGG			
								83-32-9	Acenaphthene	LT .14	UGG			
								84-66-2	Diethyl phthalate	LT .14	UGG			
								84-74-2	Di-n-butyl phthalate	LT .14	UGG			
								85-01-8	Phenanthrene	LT .14	UGG			
								85-68-7	Butylbenzyl phthalate	LT .14	UGG			
								86-30-6	N-Nitrosodiphenylamine	LT .14	UGG			
								86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG			
								86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG			
								87-68-3	Hexachlorobutadiene / Hexachloro-1,3-	LT .14	UGG			





156-59-2	Tetrachloroethene / Perchloroethylen*	LT 1.0 E -2	UGG
156-60-5	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG
56-23-5	trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG
591-78-6	Carbon tetrachloride	LT 1.0 E -2	UGG
67-64-1	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG
67-66-3	Acetone	.13	UGG B
71-43-2	Chloroform	LT 1.0 E -2	UGG
71-55-6	Benzene	LT 1.0 E -2	UGG
74-83-9	1,1,1-Trichloroethane	LT 1.0 E -2	UGG
74-87-3	Bromomethane	LT 1.0 E -2	UGG
75-00-3	Chloromethane	LT 1.0 E -2	UGG
75-01-4	Chloroethane	LT 1.0 E -2	UGG
75-09-2	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG
75-15-0	Methylene chloride / Dichloromethane	6.6 E -4	UGG JP
75-25-2	Carbon disulfide	LT 1.0 E -2	UGG
75-27-4	Bromoform	LT 1.0 E -2	UGG
75-34-3	Bromodichloromethane	LT 1.0 E -2	UGG
75-35-4	1,1-Dichloroethane	LT 1.0 E -2	UGG
75-43-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG
75-69-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG
78-87-5	Trichlorofluoromethane	LT 1.0 E -2	UGG
78-93-3	1,2-Dichloropropane	LT 1.0 E -2	UGG
79-00-5	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG
79-01-6	1,1,2-Trichloroethane	LT 1.0 E -2	UGG
79-34-5	Trichloroethylene / Trichloroethene / Ethinyl trichloride / T*	LT 1.0 E -2	UGG
	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG
	Xylenes, total combined	LT 1.0 E -2	UGG
	trans-1,3-Dichloropropene	LT 1.0 E -2	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 216 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-6	SAIC01	0.0	16-MAY-97	ES	SNSA*685	HBG1/S	120-36-5	2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG	
									Dichloroprop			
									Dicamba / 2-Methoxy-3,6-	LT 1.00 E -2	UGG	

7085-19-0	dichlorobenzoic acid (+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP / *	LT .2	UGG
75-99-0	Dalapon / alpha, alpha-Dichloropropionic acid / 2,2-Dichloro*	LT 1.00 E -2	UGG
88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG
93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG
93-76-5	245TP / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG
94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolyl)*	LT .2	UGG
94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG
94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG
118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG
121-14-2	2,4-Dinitrotoluene	LT .1	UGG
121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG
2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG
479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG
606-20-2	2,6-Dinitrotoluene	LT .2	UGG
88-72-2	2-Nitrotoluene	LT .4	UGG
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG
99-08-1	3-Nitrotoluene	LT .4	UGG
99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG
99-65-0	1,3-Dinitrobenzene	LT .1	UGG
99-99-0	4-Nitrotoluene	LT .4	UGG
	2-Amino-4,6-dinitrotoluene	LT .2	UGG
	4-Amino-2,6-dinitrotoluene	LT .2	UGG
GS2/S 7440-38-2	Arsenic	2.13	UGG
GPB1/S 7439-92-1	Lead	8.98	UGG
GSB2/S 7440-36-0	Antimony	LT .305	UGG
GSE2/S 7782-49-2	Selenium	LT .25	UGG
GTL2/S 7440-28-0	Thallium	LT .2	UGG

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

- 217 -

Final Documentation Appendix Report  
Installation: Fort Sheridan, IL (SN)  
File Type: CSE

16:17:59

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-6	SAIC01	0.0	16-MAY-97	UB	97U01657	HGC1/S ICP3/S	7439-97-6	Mercury	LT .1	UGG		
								7429-90-5	Aluminum	2680	UGG		
								7439-99-6	Iron	6810	UGG		
								7439-95-4	Magnesium	28800	UGG		
								7439-96-5	Manganese	217	UGG		
								7439-98-7	Molybdenum	.923	UGG JP	J	
								7440-02-0	Nickel	5.39	UGG		
								7440-09-7	Potassium	544	UGG		
								7440-22-4	Silver	LT .5	UGG	J	
								7440-23-5	Sodium	424	UGG		
								7440-31-5	Tin	LT 5	UGG	J	
								7440-39-3	Barium	9.34	UGG JP		
								7440-41-7	Beryllium	8.31 E -2	UGG JP		
								7440-42-8	Boron	10.7	UGG		
								7440-43-9	Cadmium	.411	UGG JP		
								7440-47-3	Chromium	5.99	UGG		
								7440-48-4	Cobalt	2.77	UGG		
								7440-50-8	Copper	9.39	UGG		
								7440-62-2	Vanadium	17	UGG		
								7440-66-6	Zinc	37.3	UGG		
								7440-70-2	Calcium	60900	UGG		
							PST2/S	1024-57-3	Heptachlor epoxide	4.71 E -4	UGG JP		
								1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG		
								1104-28-2	PCB 1221	LT 1.30 E -2	UGG		
								11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
								309-00-2	Aldrin	5.94 E -4	UGG JP		
								319-84-6	alpha-Hexachlorocyclohexane / alpha-benzene hexachloride	LT 1.00 E -3	UGG		
								319-85-7	beta-Hexachlorocyclohexane / beta-benzene hexachloride	7.94 E -4	UGG BJP		
								319-86-8	delta-Hexachlorocyclohexane / delta-benzene hexachloride	1.27 E -3	UGG BU		
								33213-65-9	Endosulfan II / beta-Endosulfan	4.85 E -4	UGG JP		
								50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	8.48 E -4	UGG JP		
								5103-71-9	alpha-Chlordane	3.57 E -4	UGG JP	I	
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG		
								53494-70-5	Endrin ketone	4.08 E -4	UGG JP		
								5566-34-7	gamma-Chlordane	4.74 E -4	UGG JP		
								58-89-9					

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-6	SAIC01	0.0	16-MAY-97	UB	97U01657	PST2/S	58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc*	8.85 E -4	UGG JP	
							60-57-1	Dieldrin	4.14 E -4	UGG JP		
							72-20-8	Endrin	5.70 E -4	UGG B3JP		
							72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethylidene*	1.54 E -3	UGG JP		
							72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	2.08 E -3	UGG C		
							72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	8.46 E -4	UGG JP		
							7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG		
							76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetra*	3.42 E -4	UGG JP		
							8001-35-2	Toxaphene / Chlorinated camphene / Campechlor / Alltox / *	LT .1	UGG		
							959-98-8	Endosulfan I / alpha-Endosulfan	LT 1.00 E -3	UGG		
							100-01-6	4-Nitroaniline	LT .14	UGG		
							100-02-7	4-Nitrophenol	LT .14	UGG		
							100-51-6	Benzyl alcohol	LT .14	UGG		
							105-67-9	2,4-Dimethylphenol	LT .14	UGG		
							106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG		
							106-46-7	1,4-Dichlorobenzene	LT .14	UGG		
							106-47-8	4-Chloroaniline	LT .14	UGG		
							108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG		
							108-95-2	Phenol / Carboic acid / Phenic acid / Phenylac acid / Phe*	LT .14	UGG		
							111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG		
							111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG		
							117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG		
							117-84-0	Di-n-octyl phthalate	LT .14	UGG		
							118-74-1	Hexachlorobenzene	LT .14	UGG		
							120-12-7	Anthracene	LT .14	UGG		
							120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
							120-83-2	2,4-Dichlorophenol	LT .14	UGG		
							121-14-2	2,4-Dinitrotoluene	LT .14	UGG		
							129-00-0	Benzo(def)phenanthrene / Pyrene	LT .14	UGG JP		
							131-11-3	Dimethyl phthalate	1.5 E -2	UGG		
							132-64-9	Dibenzofuran	LT .14	UGG		
							191-24-2	Benzo(ghi)perylene	LT .14	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

- 219 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag	Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-6	SAIC01	0.0	16-MAY-97	UB	97U01657 SMV3/S	208-96-8	Acenaphthylene	LT .14	UGG			
							218-01-9	Chrysene	LT .14	UGG			
							50-32-8	Benzo[a]pyrene	LT .14	UGG			
							51-28-5	2,4-Dinitrophenol	LT .14	UGG	2		
							53-70-3	Dibenz[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG			
							534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG			
							541-73-1	1,3-Dichlorobenzene	LT .14	UGG			
							56-55-3	Benzo[a]anthracene	LT .14	UGG			
							59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG			
							606-20-2	2,6-Dinitrotoluene	LT .14	UGG			
							621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG			
							65-85-0	Benzoic acid	3.4 E -2	UGG	JP		
							67-72-1	Hexachloroethane	LT .14	UGG			
							77-47-4	Hexachlorocyclopentadiene	LT .14	UGG	2		
							78-59-1	Isophorone	LT .14	UGG			
							83-32-9	Acenaphthene	LT .14	UGG			
							84-66-2	Diethyl phthalate	LT .14	UGG			
							84-74-2	Di-n-butyl phthalate	.1	UGG	JP		
							85-01-8	Phenanthrene	1.7 E -2	UGG	JP		
							85-68-7	Butylbenzyl phthalate	LT .14	UGG			
							86-30-6	N-Nitrosodiphenylamine	LT .14	UGG			
							86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG			
							86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG			
							87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG			
							87-86-5	Pentachlorophenol	LT .14	UGG			
							88-06-2	2,4,6-Trichlorophenol	LT .14	UGG			
							88-74-4	2-Nitroaniline	LT .14	UGG			

88-75-5	2-Nitrophenol	LT .14	UGG
91-20-3	Naphthalene / Tar camphor	LT .14	UGG
91-57-6	2-Methylnaphthalene	LT .14	UGG
91-58-7	2-Chloronaphthalene	LT .14	UGG
91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG
95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG
95-50-1	1,2-Dichlorobenzene	LT .14	UGG
95-57-8	2-Chlorophenol	LT .14	UGG
95-95-4	2,4,5-Trichlorophenol	LT .14	UGG
98-95-3	Nitrobenzene / Essence of mirbane /	LT .14	UGG
	Oil of mirbane		
99-09-2	3-Nitroaniline	LT .14	UGG
	4-Bromophenyl phenyl ether	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 220 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Matrix	Meth/ CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-6	SAIC01	0.0	16-MAY-97	UB	97U01657	SWV3/S	4-Chlorophenyl phenyl ether	LT .14	UGG		
							VMS4/S	Ethylbenzene	LT 1.0 E -2	UGG		
								Styrene / Ethenylbenzene / Styrol /	LT 1.0 E -2	UGG		
								Styrolene / Cinnamene *				
								cis-1,3-Dichloropropylene / cis-1,3-	LT 1.0 E -2	UGG		
								Dichloropropene				
								1,2-Dichloroethane	LT 1.0 E -2	UGG		
								Vinyl acetate / Acetic acid vinyl	LT 1.0 E -2	UGG		
								ester				
								Methyl isobutyl ketone /	LT 1.0 E -2	UGG		
								Isopropylacetone / 4-Methyl-2-pen*				
								Toluene	LT 1.0 E -2	UGG		
								Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG		
								2-Chloroethyl vinyl ether / (2-	LT 1.0 E -2	UGG		
								Chloroethoxy)ethene				
								Dibromochloromethane /	LT 1.0 E -2	UGG		
								Chlorodibromomethane				
								Tetrachloroethylene /	LT 1.0 E -2	UGG		
								Tetrachloroethene / Perchloroethylen*				
								cis-1,2-Dichloroethylene / cis-1,2-	LT 1.0 E -2	UGG		
								Dichloroethene				
								trans-1,2-Dichloroethylene / trans-	LT 1.0 E -2	UGG		
								1,2-Dichloroethene				

56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG
591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG
67-64-1	Acetone	.4	UGG B
67-66-3	Chloroform	LT 1.0 E -2	UGG
71-43-2	Benzene	LT 1.0 E -2	UGG
71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG
74-83-9	Bromomethane	LT 1.0 E -2	UGG
74-87-3	Chloromethane	LT 1.0 E -2	UGG
75-00-3	Chloroethane	LT 1.0 E -2	UGG
75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG
75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG
75-15-0	Carbon disulfide	LT 1.0 E -2	UGG
75-25-2	Bromoform	LT 1.0 E -2	UGG
75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG
75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG
75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG
75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG
75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG
78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG
78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 221 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-NORTH-6	SAIC01	0.0	16-MAY-97	UB	97U01657	VMS4/S	79-00-5 79-01-6 79-34-5	1,1,2-Trichloroethane Trichloroethylene / Trichloroethene / Ethinyl trichloride / T* Tetrachloroethane / 1,1,2,2- Tetrachloroethane / Acetylene * Xylenes, total combined trans-1,3-Dichloropropene 2-(2,4-Dichlorophenoxy)propionic acid Dichloroprop Dicamba / 2-Methoxy-3,6- dichlorobenzoic acid (+/-)-2-(4-Chloro-2- methylphenoxy)propanoic acid / MCPP / *	LT 1.0 E -2 LT 1.0 E -2 LT 1.0 E -2 LT 1.00 E -2 LT 1.0 E -2 LT 1.00 E -2 LT .2	UGG UGG UGG UGG UGG UGG UGG		
SD-SOUTH-1	SAIC01		0.0	14-MAY-97	ES	SNSA*683	HSG1/S	120-36-5 1918-00-9 7085-19-0			UGG UGG UGG		
								75-99-0	Dalapon / alpha, alpha-	LT 1.00 E -2	UGG		

88-85-7	Dichloropropionic acid / 2,2-Dichloro*	LT 1.00 E -2	UGG
93-72-1	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG
93-76-5	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG
94-74-6	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT .2	UGG
94-75-7	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolylo*	LT 1.00 E -2	UGG
94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG
118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG
121-14-2	2,4-Dinitrotoluene	LT .1	UGG
121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG
2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG
479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG
606-20-2	2,6-Dinitrotoluene	LT .2	UGG
88-72-2	2-Nitrotoluene	LT .4	UGG
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG
99-08-1	3-Nitrotoluene	LT .4	UGG
99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG
99-65-0	1,3-Dinitrobenzene	LT .1	UGG
99-99-0	4-Nitrotoluene	LT .4	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 222 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-1	SAIC01	0.0	14-MAY-97	UB	97U01658	EXL4/S	2-Amino-4,6-dinitrotoluene	LT .2	UGG		
								4-Amino-2,6dinitrotoluene	LT .2	UGG		
								Arsenic	2.59	UGG		
								Lead	8.09	UGG		
								Antimony	LT .305	UGG		
								Selenium	LT .25	UGG		
								Thallium	LT .2	UGG		



Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Meth/	Lab Anly. No.	CAS No.	Analyte Description	Me Bo Conc	Unit Flag	Data Meas Codes	EPA Data Quals
UGG								Mercury	LT .1	UGG		
UGG								Aluminum	2740	UGG		
UGG								Iron	7810	UGG		
UGG								Magnesium	20100	UGG		
UGG								Manganese	192	UGG		
UGG								Molybdenum	1.39	UGG		
UGG								Nickel	5.11	UGG		
UGG								Potassium	590	UGG		
UGG								Silver	LT .5	UGG		
UGG								Sodium	396	UGG		
UGG								Tin	LT 5	UGG		
UGG								Barium	8.97	UGG	JP	
UGG								Beryllium	.136	UGG	JP	
UGG								Boron	9.78	UGG		
UGG								Cadmium	LT .5	UGG		
UGG								Chromium	7.05	UGG		
UGG								Cobalt	3.12	UGG		
UGG								Copper	4.19	UGG		
UGG								Vanadium	25.3	UGG		
UGG								Zinc	27.7	UGG		
UGG								Calcium	43200	UGG		
UGG								Heptachlor epoxide	5.07 E -4	UGG	JP	
UGG								Endosulfan sulfate	LT 1.00 E -3	UGG		
UGG								PCB 1221	LT 1.30 E -2	UGG		
UGG								PCB 1260	LT 1.30 E -2	UGG		
UGG								PCB 1254	LT 1.30 E -2	UGG		
UGG								PCB 1232	LT 1.30 E -2	UGG		
UGG								PCB 1248	LT 1.30 E -2	UGG		
UGG								PCB 1016	LT 1.30 E -2	UGG		
UGG								Aldrin	6.14 E -4	UGG	JP	
UGG								alpha-Hexachlorocyclohexane / alpha-	LT 1.00 E -3	UGG		
UGG								Benzene hexachloride		UGG		
UGG								beta-Hexachlorocyclohexane / beta-	7.54 E -4	UGG	BJP	
UGG								Benzene hexachloride		UGG		
UGG								delta-Hexachlorocyclohexane / delta-	1.44 E -3	UGG	BU	
UGG								Benzene hexachloride		UGG		
UGG								Endosulfan II / beta-Endosulfan	LT 1.00 E -3	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

- 223 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

LAKE	SD-SOUTH-1	SAICOL	0.0	14-MAY-97	UB	97U01658	PST2/S	50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	2.40 E -3	UGG	C
								5103-71-9	alpha-Chlordane	3.50 E -4	UGG	JP
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG	
								53494-70-5	Endrin ketone	3.91 E -4	UGG	JP
								5566-34-7	gamma-Chlordane	4.89 E -4	UGG	JP
								58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc*	9.54 E -4	UGG	JP
								60-57-1	Dieldrin	6.03 E -4	UGG	JP
								72-20-8	Endrin	5.51 E -4	UGG	BJP
								72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethylidene*	1.59 E -3	UGG	JP
								72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	6.49 E -3	UGG	C
								72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	1.69 E -3	UGG	C
								7421-93-4	Endrin aldehyde	LT 1.00 E -3	UGG	
								76-44-8	Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetra*	3.91 E -4	UGG	JP
								8001-35-2	Toxaphene / Chlorinated camphene / Campechlor / Alltox / *	LT .1	UGG	
								959-98-8	Endosulfan I / alpha-Endosulfan	LT 1.00 E -3	UGG	
							SHV3/S	100-01-6	4-Nitroaniline	LT .14	UGG	
								100-02-7	4-Nitrophenol	LT .14	UGG	
								100-51-6	Benzyl alcohol	LT .14	UGG	
								105-67-9	2,4-Dimethylphenol	LT .14	UGG	
								106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG	
								106-46-7	1,4-Dichlorobenzene	LT .14	UGG	
								106-47-8	4-Chloroaniline	LT .14	UGG	
								108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG	
								108-95-2	Phenol / Carboic acid / Phenic acid / Phenyl acid / Phe*	LT .14	UGG	
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG	
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG	
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG	2
								117-84-0	Di-n-octyl phthalate	LT .14	UGG	2
								118-74-1	Hexachlorobenzene	LT .14	UGG	
								120-12-7	Anthracene	LT .14	UGG	
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG	
								120-83-2	2,4-Dichlorophenol	LT .14	UGG	
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG	
								129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG	
								131-11-3	Dimethyl phthalate	2.5 E -2	UGG	JP
								132-64-9	Dibenzofuran	LT .14	UGG	

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-1	SAIC01	0.0	14-MAY-97	UB	97U01658	SKW3/S						
							191-24-2	Benzo[ghi]perylene	LT .14	UGG			
							193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG			
							205-99-2	Benzo[b]fluoranthene / 3,4-Benzofluoranthene	LT .14	UGG			
							206-44-0	Fluoranthene	2.5 E -2	UGG	JP		
							207-08-9	Benzo[k]fluoranthene	LT .14	UGG			
							208-96-8	Acenaphthylene	LT .14	UGG			
							218-01-9	Chrysene	LT .14	UGG			
							50-32-8	Benzo[a]pyrene	LT .14	UGG			
							51-28-5	2,4-Dinitrophenol	LT .14	UGG			
							53-70-3	Dibenz[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG			
							534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG			
							541-73-1	1,3-Dichlorobenzene	LT .14	UGG			
							56-55-3	Benzo[a]anthracene	LT .14	UGG			
							59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m <sup>+</sup> cresol	LT .14	UGG			
							606-20-2	2,6-Dinitrotoluene	LT .14	UGG			
							621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG			
							65-85-0	Benzoic acid	1.7 E -2	UGG	JP		
							67-72-1	Hexachloroethane	LT .14	UGG			
							77-47-4	Hexachlorocyclopentadiene	LT .14	UGG			
							78-59-1	Isophorone	LT .14	UGG			
							83-32-9	Acenaphthene	LT .14	UGG			
							84-66-2	Diethyl phthalate	LT .14	UGG			
							84-74-2	Di-n-butyl phthalate	LT .14	UGG			
							85-01-8	Phenanthrene	LT .14	UGG			
							85-68-7	Butylbenzyl phthalate	2.5 E -2	UGG	JP		
							86-30-6	N-Nitrosodiphenylamine	LT .14	UGG			
							86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG			
							86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG			
							87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG			
							87-86-5	Pentachlorophenol	LT .14	UGG			
							88-06-2	2,4,6-Trichlorophenol	LT .14	UGG			
							88-74-4	2-Nitroaniline	LT .14	UGG			
							88-75-5	2-Nitrophenol	LT .14	UGG			
							91-20-3	Naphthalene / Tar camphor	LT .14	UGG			
							91-57-6	2-Methylnaphthalene	LT .14	UGG			
							91-58-7	2-Chloronaphthalene	LT .14	UGG			
							91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG			
							95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG			

\* - Analyte Description has been truncated. See Data Dictionary

95-50-1 1,2-Dichlorobenzene LT .14 UGG

- 225 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-1	SAIC01	0.0	14-MAY-97	UB	97U01658	SNV3/S	95-57-8	2-Chlorophenol	LT .14	UGG		
								95-95-4	2,4,5-Trichlorophenol	LT .14	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG		
								99-09-2	3-Nitroaniline	LT .14	UGG		
									4-Bromophenyl phenyl ether	LT .14	UGG		
									4-Chlorophenyl phenyl ether	LT .14	UGG		
									Ethylbenzene	LT 1.0 E -2	UGG		
									Styrene / Ethenylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG		
								10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG		
								107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG		
								108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG		
								108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pent	LT 1.0 E -2	UGG		
								108-88-3	Toluene	LT 1.0 E -2	UGG		
								108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG		
								110-75-8	2-Chloroethyl vinyl ether / 2-Chloroethoxyethene	LT 1.0 E -2	UGG		
								124-48-1	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG		
								127-18-4	Tetrachloroethene / Perchloroethylen*	LT 1.0 E -2	UGG		
								156-59-2	cis-1,2-Dichloroethylen / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG		
								156-60-5	trans-1,2-Dichloroethylen / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG		
								56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG		
								591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG		
								67-64-1	Acetone	LT 1.0 E -2	UGG		
								67-66-3	Chloroform	LT 1.0 E -2	UGG		
								71-43-2	Benzene	LT 1.0 E -2	UGG		
								71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG		

74-83-9	Bromomethane	LT 1.0 E -2	UGG
74-87-3	Chloromethane	LT 1.0 E -2	UGG
75-00-3	Chloroethane	LT 1.0 E -2	UGG
75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG
75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG
75-15-0	Carbon disulfide	LT 1.0 E -2	UGG
75-25-2	Bromoform	LT 1.0 E -2	UGG
75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG
75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 226 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-1	SAIC01	0.0	14-MAY-97	UB	97U01658	VMS4/S	75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG		
								75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG		
								75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG		
								78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG		
								78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG		
								79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG		
								79-01-6	Trichloroethylene /Trichloroethene / Ethinyl trichloride /T*	LT 1.0 E -2	UGG		
								79-34-5	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG		
									Xylenes, total combined	LT 1.0 E -2	UGG		
									trans-1,3-Dichloropropene	LT 1.0 E -2	UGG		
SD-SOUTH-2	SAIC01		0.0	16-MAY-97	ES	SNSA*682	HBG1/S	120-36-5	2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG		
									Dichloroprop				
								1918-00-9	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG		
								7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP / *	LT .2	UGG		
								75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichloro*	LT 1.00 E -2	UGG		
								88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG		
								93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG		
								93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic	LT 1.00 E -2	UGG		

acid / Trioxone / We\*  
 (4-Chloro-2-methylphenoxy)acetic acid LT .2 UGG  
 / (4-Chloro-o-tolylo\*  
 2,4-D / 2,4-Dichlorophenoxyacetic LT 1.00 E -2 UGG  
 acid  
 2,4-DB / 4-(2,4- LT 1.00 E -2 UGG  
 Dichlorophenoxy)butyric acid  
 2,4,6-Trinitrotoluene / alpha- LT .2 UGG  
 Trinitrotoluene  
 2,4-Dinitrotoluene LT .1 UGG  
 RDX / Cyclonite / Hexahydro-1,3,5- LT .2 UGG  
 trinitro-1,3,5-triazine \*  
 Cyclotetramethylenetetranitramine LT .2 UGG  
 Tetrayl / N-Methyl-N,2,4,6- LT .2 UGG  
 tetranitroaniline / Nitramine / \*  
 2,6-Dinitrotoluene LT .2 UGG  
 2-Nitrotoluene LT .4 UGG

UB 97U01659 EXL4/S 118-96-7

\* - Analyte Description has been truncated. See Data Dictionary

- 227 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-2	SAIC01	0.0	16-MAY-97	UB	97U01659	EXL4/S	98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
								99-08-1	3-Nitrotoluene	LT .4	UGG		
								99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
								99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
								99-99-0	4-Nitrotoluene	LT .4	UGG		
									2-Amino-4,6-dinitrotoluene	LT .2	UGG		
									4-Amino-2,6-dinitrotoluene	LT .2	UGG		
									Arsenic	2.81	UGG		
									Lead	5.13	UGG		
									Antimony	LT .305	UGG		
									Selenium	LT .25	UGG		
									Thallium	LT .2	UGG		
									Mercury	LT .1	UGG		
									Aluminum	2080	UGG		
									Iron	9920	UGG		
									Magnesium	11400	UGG		
									Manganese	148	UGG		
									Molybdenum	1.54	UGG		

J

7440-02-0	Nickel	5.47	UGG	
7440-09-7	Potassium	517	UGG	
7440-22-4	Silver	LT .5	UGG	J
7440-23-5	Sodium	264	UGG	
7440-31-5	Tin	LT 5	UGG	J
7440-39-3	Barium	8.52	UGG JP	
7440-41-7	Beryllium	5.55 E -2	UGG JP	
7440-42-8	Boron	3.94	UGG JP	
7440-43-9	Cadmium	LT .5	UGG	
7440-47-3	Chromium	4.81	UGG	
7440-48-4	Cobalt	2.48	UGG	
7440-50-8	Copper	4.26	UGG	
7440-62-2	Vanadium	9.39	UGG	
7440-66-6	Zinc	18.4	UGG	
7440-70-2	Calcium	25100	UGG	
PST2/S 1024-57-3	Heptachlor epoxide	3.13 E -4	UGG JP	
1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG	
1104-28-2	PCB 1221	LT 1.30 E -2	UGG	
11096-82-5	PCB 1260	LT 1.30 E -2	UGG	
11097-69-1	PCB 1254	LT 1.30 E -2	UGG	
11141-16-5	PCB 1232	LT 1.30 E -2	UGG	
12672-29-6	PCB 1248	LT 1.30 E -2	UGG	
12674-11-2	PCB 1016	LT 1.30 E -2	UGG	
309-00-2	Aldrin	5.26 E -4	UGG JP	
319-84-6				

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-2	SAIC01	0.0	16-MAY-97	UB	97U01659	PST2/S	319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	LT 1.00 E -3	UGG		
								319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	4.89 E -4	UGG	BJP	
								319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.19 E -3	UGG	BJP	
								33213-65-9	Endosulfan II / beta-Endosulfan	LT 1.00 E -3	UGG		
								50-29-3	2,2-Bis (p-chlorophenyl) -1,1,1-trichloroethane	1.91 E -3	UGG	C	
								5103-71-9	alpha-Chlordane	LT 1.00 E -3	UGG		I
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG		

53494-70-5	Endrin ketone	3.71 E -4	UGG JP
5566-34-7	gamma-Chlordane	2.88 E -4	UGG JP
58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc*	7.24 E -4	UGG JP
60-57-1	Dieldrin	3.39 E -4	UGG JP
72-20-8	Endrin	4.99 E -4	UGG BJP
72-43-5	Methoxychlor / Methoxy-DDT / 1,1'- (2,2,2-Trichloroethylidene* p,p'-DD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	1.87 E -3	UGG JP
72-54-8	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	3.31 E -3	UGG C
72-55-9	Endrin aldehyde	1.01 E -3	UGG JP
7421-93-4	Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7a-tetra*	LT 1.00 E -3	UGG
76-44-8	Toxaphene / Chlorinated camphene / Camphchlor / Alltox / *	LT .1	UGG
8001-35-2	Endosulfan I / alpha-Endosulfan	3.05 E -4	UGG JP
959-98-8	4-Nitroaniline	LT .14	UGG
100-01-6	4-Nitrophenol	LT .14	UGG
100-02-7	Benzyl alcohol	LT .14	UGG
100-51-6	2,4-Dimethylphenol	LT .14	UGG
105-67-9	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG
106-44-5	1,4-Dichlorobenzene	LT .14	UGG
106-46-7	4-Chloroaniline	LT .14	UGG
106-47-8	Bis(2-chloroisopropyl) ether	LT .14	UGG
108-60-1	Phenol / Carboic acid / Phenic acid	LT .14	UGG
108-95-2	/ Phenylic acid / Phe*	LT .14	UGG
111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG
111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG
117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG
117-84-0	Di-n-octyl phthalate	LT .14	UGG
118-74-1	Hexachlorobenzene	LT .14	UGG

SNV3/S

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-2	SAIC01	0.0	16-MAY-97	UB	97U01659	SNV3/S	120-12-7	Anthracene	LT .14	UGG		
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
								120-83-2	2,4-Dichlorophenol	LT .14	UGG		



121-14-2	2,4-Dinitrotoluene	LT .14	UGG
129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG
131-11-3	Dimethyl phthalate	LT .14	UGG
132-64-9	Dibenzofuran	LT .14	UGG
191-24-2	Benzo[ghi]perylene	LT .14	UGG
193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG
205-99-2	Benzo[b]fluoranthene / 3,4-Benzo[fluoranthene	LT .14	UGG
206-44-0	Fluoranthene	LT .14	UGG
207-08-9	Benzo[k]fluoranthene	LT .14	UGG
208-96-8	Acenaphthylene	LT .14	UGG
218-01-9	Chrysene	LT .14	UGG
50-32-8	Benzo[a]pyrene	LT .14	UGG
51-28-5	2,4-Dinitrophenol	LT .14	UGG 2
53-70-3	Dibenzo[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG
534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG
541-73-1	1,3-Dichlorobenzene	LT .14	UGG
56-55-3	Benzo[a]anthracene	LT .14	UGG
59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG
606-20-2	2,6-Dinitrotoluene	LT .14	UGG
621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG
65-85-0	Benzoic acid	LT .14	UGG
67-72-1	Hexachloroethane	LT .14	UGG
77-47-4	Hexachlorocyclopentadiene	LT .14	UGG 2
78-59-1	Isophorone	LT .14	UGG
83-32-9	Acenaphthene	LT .14	UGG
84-66-2	Diethyl phthalate	LT .14	UGG
84-74-2	Di-n-butyl phthalate	LT .14	UGG
85-01-8	Phenanthrene	LT .14	UGG
85-68-7	Butylbenzyl phthalate	1.7 E -2	UGG JP
86-30-6	N-Nitrosodiphenylamine	LT .14	UGG
86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG
86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG
87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG
87-86-5	Pentachlorophenol	LT .14	UGG
88-06-2	2,4,6-Trichlorophenol	LT .14	UGG
88-74-4	2-Nitroaniline	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Any.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-2	SAIC01	0.0	16-MAY-97	UB	97U01659	SMV3/S	88-75-5	2-Nitrophenol	LT .14	UGG		
								91-20-3	Naphthalene / Tar camphor	LT .14	UGG		
								91-57-6	2-Methylnaphthalene	LT .14	UGG		
								91-58-7	2-Chloronaphthalene	LT .14	UGG		
								91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG		
								95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG		
								95-50-1	1,2-Dichlorobenzene	LT .14	UGG		
								95-57-8	2-Chlorophenol	LT .14	UGG		
								95-95-4	2,4,5-Trichlorophenol	LT .14	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG		
								99-09-2	3-Nitroaniline	LT .14	UGG		
									4-Bromophenyl phenyl ether	LT .14	UGG		
									4-Chlorophenyl phenyl ether	LT .14	UGG		
									Ethylbenzene	LT 1.0 E -2	UGG		
									Styrene / Ethylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG		
								10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG		
								107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG		
								108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG		
								108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pen*	LT 1.0 E -2	UGG		
								108-88-3	Toluene	LT 1.0 E -2	UGG		
								108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG		
								110-75-8	2-Chloroethyl vinyl ether / 12-Chloroethoxyethene	LT 1.0 E -2	UGG		
								124-48-1	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG		
								127-18-4	Tetrachloroethylene / Perchloroethylen*	LT 1.0 E -2	UGG		
								156-59-2	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG		
								156-60-5	trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG		
								56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG		
								591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG		
								67-64-1	Acetone	1.2 E -2	UGG		
								67-66-3	Chloroform	LT 1.0 E -2	UGG		
								71-43-2	Benzene	LT 1.0 E -2	UGG		
								71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG		
								74-83-9	Bromomethane	LT 1.0 E -2	UGG		
								74-87-3	Chloromethane	LT 1.0 E -2	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-2	SAIC01	0.0	16-MAY-97	UB	97U01659 VMS4/S	75-00-3	Chloroethane	LT 1.0 E -2	UGG		
							75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG		
							75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG		
							75-15-0	Carbon disulfide	LT 1.0 E -2	UGG		
							75-25-2	Bromoform	LT 1.0 E -2	UGG		
							75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG		
							75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG		
							75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG		
							75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG		
							75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG		
							78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG		
							78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG		
							79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG		
							79-01-6	Trichloroethylene /Trichloroethene / Ethinyl trichloride /T*	LT 1.0 E -2	UGG		
							79-34-5	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG		
								Xylenes, total combined	LT 1.0 E -2	UGG		
								trans-1,3-Dichloropropene	LT 1.0 E -2	UGG		
SD-SOUTH-3	SAIC01		0.0	16-MAY-97	ES	SNSA*684 HBGI/S	120-36-5	2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG		
							1918-00-9	Dichloroprop	LT 1.00 E -2	UGG		
								Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT .2	UGG		
							7085-19-0	(+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP *				
							75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichloro*	LT 1.00 E -2	UGG		
							88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG		
							93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG		
							93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG		
							94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolyl)*	LT .2	UGG		
							94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

- 232 -

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE 30-JAN-98  
Sampling Date Range: 01-SEP-96

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-3	SAIC01	0.0	16-MAY-97	UB	97U01660	EXL4/S	121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
								2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
								479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
								606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
								88-72-2	2-Nitrotoluene	LT .4	UGG		
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
								99-08-1	3-Nitrotoluene	LT .4	UGG		
								99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
								99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
								99-99-0	4-Nitrotoluene	LT .4	UGG		
									2-Amino-4,6-dinitrotoluene	LT .2	UGG		
									4-Amino-2,6-dinitrotoluene	LT .2	UGG		
									Arsenic	2.27	UGG		
									Lead	4.8	UGG		
									Antimony	LT .305	UGG		
									Selenium	LT .25	UGG		
									Thallium	LT .2	UGG		
									Mercury	LT .1	UGG		
									Aluminum	2790	UGG		
									Iron	10200	UGG		
									Magnesium	41700	UGG		
									Manganese	257	UGG		
									Molybdenum	LT 1	UGG	J	
									Nickel	5.83	UGG		
									Potassium	497	UGG		
									Silver	LT .5	UGG	J	
									Sodium	510	UGG		
									Tin	LT 5	UGG	J	

7440-39-3 Barium UGG JP  
7440-41-7 Beryllium UGG JP  
7440-42-8 Boron UGG  
7440-43-9 Cadmium UGG  
7440-47-3 Chromium UGG  
7440-48-4 Cobalt UGG  
7440-50-8 Copper UGG  
7440-62-2 Vanadium UGG  
7440-66-6 Zinc UGG  
7440-70-2 Calcium UGG  
PST2/S 1024-57-3 Heptachlor epoxide UGG JP  
1031-07-8 Endosulfan sulfate UGG  
1104-28-2 PCB 1221 UGG

.9.7  
.129  
6.32  
.635  
8.87  
3.61  
4.25  
41.2  
51.2  
86000  
4.08 E -4  
LT 1.00 E -3  
LT 1.30 E -2

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

- 233 -

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-3	SAIC01	0.0	16-MAY-97	UB	97U01660	PST2/S	11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
								309-00-2	Aldrin	5.52 E -4	UGG JP		
								319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	LT 1.00 E -3	UGG		
								319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	6.86 E -4	UGG BJP		
								319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.16 E -3	UGG BJP		
								33213-65-9	Endosulfan II / beta-Endosulfan	2.80 E -4	UGG JP		
								50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	7.67 E -4	UGG JP		
								5103-71-9	alpha-Chlordane	3.45 E -4	UGG JP	I	
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG		
								53494-70-5	Endrin ketone	3.82 E -4	UGG JP		
								5566-34-7	gamma-Chlordane	3.70 E -4	UGG JP		
								58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc	7.93 E -4	UGG JP		
								60-57-1	Dieldrin	4.42 E -4	UGG JP		
								72-20-8	Endrin	4.99 E -4	UGG BJP		

72-43-5 Methoxychlor / Methoxy-DDT / 1,1'-(2,2,2-Trichloroethylidene\*)  
 72-54-8 ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth\*  
 72-55-9 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene  
 7421-93-4 Endrin aldehyde  
 76-44-8 Heptachlor / 1H-1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydrophene / Chlorinated camphene / Camphochlor / Alltox / \*  
 8001-35-2 Endosulfan I / alpha-Endosulfan  
 959-98-8 4-Nitroaniline  
 100-01-6 4-Nitrophenol  
 100-02-7 Benzyl alcohol  
 100-51-6 2,4-Dimethylphenol  
 105-67-9 p-Cresol / 4-Cresol / 4-Methylphenol  
 106-44-5 1,4-Dichlorobenzene  
 106-46-7 4-Chloroaniline  
 106-47-8 Bis(2-chloroisopropyl) ether  
 106-60-1  
 108-95-2

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-3	SAIC01	0.0	16-MAY-97	UB	97U01660	SMV3/S	108-95-2	Phenol / Carboic acid / Phenic acid / Phenylc acid / Phe*	LT .14	UGG		
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG		
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG		
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG		
								117-84-0	Di-n-octyl phthalate	LT .14	UGG		
								118-74-1	Hexachlorobenzene	LT .14	UGG		
								120-12-7	Anthracene	LT .14	UGG		
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
								120-83-2	2,4-Dichlorophenol	LT .14	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG		
								129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG		
								131-11-3	Dimethyl phthalate	LT .14	UGG		
								132-64-9	Dibenzofuran	LT .14	UGG		
								191-24-2	Benzo[ghi]perylene	LT .14	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG
205-99-2	Benzo[b]fluoranthene / 3,4-benzofluoranthene	LT .14	UGG
206-44-0	Fluoranthene	LT .14	UGG
207-08-9	Benzo[k]fluoranthene	LT .14	UGG
208-96-8	Acenaphthylene	LT .14	UGG
218-01-9	Chrysene	LT .14	UGG
50-32-8	Benzo[a]pyrene	LT .14	UGG
51-28-5	2,4-Dinitrophenol	LT .14	UGG 2
53-70-3	Dibenz[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG
534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG
541-73-1	1,3-Dichlorobenzene	LT .14	UGG
56-55-3	Benzo[a]anthracene	LT .14	UGG
59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG
606-20-2	2,6-Dinitrotoluene	LT .14	UGG
621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG
65-85-0	Benzoic acid	LT .14	UGG
67-72-1	Hexachloroethane	LT .14	UGG
77-47-4	Hexachlorocyclopentadiene	LT .14	UGG 2
78-59-1	Isophorone	LT .14	UGG
83-32-9	Acenaphthene	LT .14	UGG
84-66-2	Diethyl phthalate	LT .14	UGG
84-74-2	Di-n-butyl phthalate	LT .14	UGG
85-01-8	Phenanthrene	LT .14	UGG
85-68-7	Butylbenzyl phthalate	LT .14	UGG
86-30-6	N-Nitrosodiphenylamine	LT .14	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 235 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-3	SAIC01	0.0	16-MAY-97	UB	97U01660	SMV3/S	Fluorene / 9H-Fluorene	LT .14	UGG		
							86-73-7	Carbazole / 9H-Carbazole	LT .14	UGG		
							86-74-8	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG		
							87-68-3					
							87-86-5	Pentachlorophenol	LT .14	UGG		
							88-06-2	2,4,6-Trichlorophenol	LT .14	UGG		
							88-74-4	2-Nitroaniline	LT .14	UGG		

88-75-5	2-Nitrophenol	LT .14	UGG
91-20-3	Naphthalene / Tar camphor	LT .14	UGG
91-57-6	2-Methylnaphthalene	LT .14	UGG
91-58-7	2-Chloronaphthalene	LT .14	UGG
91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG
95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG
95-50-1	1,2-Dichlorobenzene	LT .14	UGG
95-57-8	2-Chlorophenol	LT .14	UGG
95-59-4	2,4,5-Trichlorophenol	LT .14	UGG
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .14	UGG
99-09-2	3-Nitroaniline	LT .14	UGG
	4-Bromophenyl phenyl ether	LT .14	UGG
	4-Chlorophenyl phenyl ether	LT .14	UGG
VMS4/S 100-41-4	Ethylbenzene	LT 1.0 E -2	UGG
100-42-5	Styrene / Ethylbenzene / Styrol / Styrolene / Cinnamene *	LT 1.0 E -2	UGG
10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-Dichloropropene	LT 1.0 E -2	UGG
107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG
108-05-4	Vinyl acetate / Acetic acid vinyl ester	LT 1.0 E -2	UGG
108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pent	LT 1.0 E -2	UGG
108-88-3	Toluene	LT 1.0 E -2	UGG
108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG
110-75-8	2-Chloroethyl vinyl ether / (2-Chloroethoxy)ethene	LT 1.0 E -2	UGG
124-48-1	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG
127-18-4	Tetrachloroethylene / Tetrachloroethene / Perchloroethylen*	LT 1.0 E -2	UGG
156-59-2	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG
156-60-5	trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG
56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 236 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)

File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Sample Date	Lab Anly. No.	Lab Meth/	Analyte Description	Me Bo Conc	Unit Flag	Data Meas Codes	EPA Data Quals
-----------	---------	------------------	-------------	---------------	-----------	---------------------	------------	-----------	-----------------	----------------



LAKE	SD-SOUTH-3	SAIC01	0.0	16-MAY-97	UB	97U01660	VMS4/S	591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG
							67-64-1	67-64-1	Acetone	LT 1.0 E -2	UGG
							67-66-3	67-66-3	Chloroform	LT 1.0 E -2	UGG
							71-43-2	71-43-2	Benzene	LT 1.0 E -2	UGG
							71-55-6	71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG
							74-83-9	74-83-9	Bromomethane	LT 1.0 E -2	UGG
							74-87-3	74-87-3	Chloromethane	LT 1.0 E -2	UGG
							75-00-3	75-00-3	Chloroethane	LT 1.0 E -2	UGG
							75-01-4	75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG
							75-09-2	75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG
							75-15-0	75-15-0	Carbon disulfide	LT 1.0 E -2	UGG
							75-25-2	75-25-2	Bromoform	LT 1.0 E -2	UGG
							75-27-4	75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG
							75-34-3	75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG
							75-35-4	75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG
							75-43-4	75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG
							75-69-4	75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG
							78-87-5	78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG
							78-93-3	78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG
							79-00-5	79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG
							79-01-6	79-01-6	Trichloroethylene / Trichloroethene	LT 1.0 E -2	UGG
							79-34-5	79-34-5	Ethynyl trichloride / T* Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG
							1918-00-9	1918-00-9	Xylenes, total combined trans-1,3-Dichloropropene	LT 1.0 E -2	UGG
							120-36-5	120-36-5	2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG D
SAIC01D	0.0	16-MAY-97	ES	SNSA*679	HBG1/S		7085-19-0	7085-19-0	Dichloroprop Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid (+/-)-2-(4-Chloro-2-methylphenoxy)propanoic acid / MCPP / *	LT .2	UGG D
							75-99-0	75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichlor*	LT 1.00 E -2	UGG D
							88-85-7	88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG D
							93-72-1	93-72-1	245TP / Silvex / 2-(2,4,5-Trichlorophenoxy)propionic acid *	LT 1.00 E -2	UGG D
							93-76-5	93-76-5	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG D
							94-74-6	94-74-6	(4-Chloro-2-methylphenoxy)acetic acid / (4-Chloro-o-tolylo*	LT .2	UGG D

\* - Analyte Description has been truncated. See Data Dictionary

Final Documentation Appendix Report  
 Installation : Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-3	SAIC01D	0.0	16-MAY-97	ES	SNSA*679	H8G1/S	94-75-7	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG D			
								94-82-6	2,4-DB / 4-(2,4-Dichlorophenoxy)butyric acid	LT 1.00 E -2	UGG D			
					UB	97U01661	EXL4/S	118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG D			
								121-14-2	2,4-Dinitrotoluene	LT .1	UGG D			
								121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG D			
								2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG D			
								479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG D			
								606-20-2	2,6-Dinitrotoluene	LT .2	UGG D			
								88-72-2	2-Nitrotoluene	LT .4	UGG D			
								98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG D			
								99-08-1	3-Nitrotoluene	LT .4	UGG D			
								99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG D			
								99-65-0	1,3-Dinitrobenzene	LT .1	UGG D			
								99-99-0	4-Nitrotoluene	LT .4	UGG D			
									2-Amino-4,6-dinitrotoluene	LT .2	UGG D			
									4-Amino-2,6-dinitrotoluene	LT .2	UGG D			
									Arsenic	2.62	UGG D			
									Lead	11.5	UGG D			
									Antimony	LT .305	UGG D			
									Selenium	LT .25	UGG D			
									Thallium	LT .2	UGG D			
									Mercury	LT .1	UGG D			
									Aluminum	3100	UGG D			
									Iron	16100	UGG D			
									Magnesium	39200	UGG D			
									Manganese	267	UGG D			
									Molybdenum	LT 1	UGG D		J	
									Nickel	7.66	UGG D			
									Potassium	543	UGG D			
									Silver	LT .5	UGG D		J	
									Sodium	535	UGG D			
									Tin	LT 5	UGG D		J	
									Barium	10.4	UGG JPD			
									Beryllium	LT .5	UGG D			
									Boron	9.4	UGG D			
									Cadmium	LT .5	UGG D			
									Chromium	13.3	UGG D			

\* - Analyte Description has been truncated. See Data Dictionary

7440-48-4 Cobalt

3.51

UGG D

- 238 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAXE	SD-SOUTH-3	SAIC01D	0.0	16-MAY-97	UB	97U01561	ICP3/S	7440-50-8	Copper	5.25	UGG D		
								7440-62-2	Vanadium	71.1	UGG D		
								7440-66-6	Zinc	59.2	UGG D		
								7440-70-2	Calcium	78000	UGG D		
							PST2/S	1024-57-3	Heptachlor epoxide	4.48 E -4	UGG DJP		
								1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG D		
								1104-28-2	PCB 1221	LT 1.30 E -2	UGG D		
								11096-82-5	PCB 1260	LT 1.30 E -2	UGG D		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG D		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG D		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG D		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG D		
								309-00-2	Aldrin	6.18 E -4	UGG DJP		
								319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	8.95 E -4	UGG BDJP		
								319-85-7	beta-Hexachlorocyclohexane / beta-Benzene hexachloride	6.38 E -4	UGG BDJP		
								319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.38 E -3	UGG BCD		
								33213-65-9	Endosulfan II / beta-Endosulfan	2.94 E -4	UGG DJP		
								50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	9.51 E -4	UGG DJP		
								5103-71-9	alpha-Chlordane	3.58 E -4	UGG DJP	I	
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG D		
								53494-70-5	Endrin ketone	LT 1.00 E -3	UGG D		
								5566-34-7	gamma-Chlordane	3.81 E -4	UGG DJP		
								58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyclopentadiene	8.06 E -4	UGG DJP		
								60-57-1	Dieldrin	5.09 E -4	UGG DJP		
								72-20-8	Endrin	5.30 E -4	UGG BDJP		
								72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-bis(4-chlorophenyl)ethane	1.57 E -3	UGG DJP		
								72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	2.51 E -3	UGG CD		
								72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethane	1.10 E -3	UGG DJP		

dichloroethene  
 Endrin aldehyde  
 Heptachlor / 1H-1,4,5,6,7,8,8-  
 Heptachloro-3a,4,7,7a-tetra\*  
 Toxaphene / Chlorinated camphene /  
 Campechlor / Alltox / \*  
 Endosulfan I / alpha-Endosulfan  
 4-Nitroaniline  
 4-Nitrophenol

\* - Analyte Description has been truncated. See Data Dictionary

- 239 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-3	SAIC01D	0.0	16-MAY-97	UB	97U01661	SMV3/S	100-51-6	Benzyl alcohol	LT .14	UGG	D		
								105-67-9	2,4-Dimethylphenol	LT .14	UGG	D		
								106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG	D		
								106-46-7	1,4-Dichlorobenzene	LT .14	UGG	D		
								106-47-8	4-Chloroaniline	LT .14	UGG	D		
								108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG	D		
								108-95-2	Phenol / Carbolic acid / Phenic acid / Phenyllic acid / Phe*	LT .14	UGG	D		
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG	D		
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG	D		
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG	D		
								117-84-0	Di-n-octyl phthalate	LT .14	UGG	D		
								118-74-1	Hexachlorobenzene	LT .14	UGG	D		
								120-12-7	Anthracene	LT .14	UGG	D		
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG	D		
								120-83-2	2,4-Dichlorophenol	LT .14	UGG	D		
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG	D		
								129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG	D		
								131-11-3	Dimethyl phthalate	LT .14	UGG	D		
								132-64-9	Dibenzofuran	LT .14	UGG	D		
								191-24-2	Benzo[ghi]perylene	LT .14	UGG	D		
								193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG	D		
								205-99-2	Benzo[b]fluoranthene / 3,4-Benzofluoranthene	LT .14	UGG	D		
								206-44-0	Fluoranthene	LT .14	UGG	D		
								207-08-9	Benzo[k]fluoranthene	LT .14	UGG	D		
								208-96-8	Acenaphthylene	LT .14	UGG	D		

218-01-9	Chrysene	LT .14	UGG D
50-32-8	Benzo[a]pyrene	LT .14	UGG D
51-28-5	2,4-Dinitrophenol	LT .14	UGG D2
53-70-3	Dibenz[ah]anthracene / 1,2:5,6-Dibenzanthracene	LT .14	UGG D
534-52-1	4,6-Dinitro-2-cresol / 2-Methyl-4,6-dinitrophenol	LT .14	UGG D
541-73-1	1,3-Dichlorobenzene	LT .14	UGG D
56-55-3	Benzo[a]anthracene	LT .14	UGG D
59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG D
606-20-2	2,6-Dinitrotoluene	LT .14	UGG D
621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG D
65-85-0	Benzoic acid	LT .14	UGG D
67-72-1	Hexachloroethane	LT .14	UGG D
77-47-4	Hexachlorocyclopentadiene	LT .14	UGG D2
78-59-1	Isophorone	LT .14	UGG D

\* - Analyte Description has been truncated. See Data Dictionary

- 240 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-3	SAIC01D	0.0	16-MAY-97	UB	97U01661	SMV3/S	83-32-9	Acenaphthene	LT .14	UGG D		
								84-66-2	Diethyl phthalate	LT .14	UGG D		
								84-74-2	Di-n-butyl phthalate	LT .14	UGG D		
								85-01-8	Phenanthrene	LT .14	UGG D		
								85-68-7	Butylbenzyl phthalate	LT .14	UGG D		
								86-30-6	N-Nitrosodiphenylamine	LT .14	UGG D		
								86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG D		
								86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG D		
								87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG D		
								87-86-5	Pentachlorophenol	LT .14	UGG D		
								88-06-2	2,4,6-Trichlorophenol	LT .14	UGG D		
								88-74-4	2-Nitroaniline	LT .14	UGG D		
								88-75-5	2-Nitrophenol	LT .14	UGG D		
								91-20-3	Naphthalene / Tar camphor	LT .14	UGG D		
								91-57-6	2-Methylnaphthalene	LT .14	UGG D		
								91-58-7	2-Chloronaphthalene	LT .14	UGG D		
								91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG D		
								95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG D		

\* - Analyte Description has been truncated. See Data Dictionary

- 241 -

95-50-1	1,2-Dichlorobenzene	LT .14	UGG D
95-57-8	2-Chlorophenol	LT .14	UGG D
95-95-4	2,4,5-Trichlorophenol	LT .14	UGG D
98-95-3	Nitrobenzene / Essence of mirbane /	LT .14	UGG D
	Oil of mirbane		
99-09-2	3-Nitroaniline	LT .14	UGG D
	4-Bromophenyl phenyl ether	LT .14	UGG D
	4-Chlorophenyl phenyl ether	LT .14	UGG D
VMS4/S 100-41-4	Ethylbenzene	LT 1.0 E -2	UGG D
100-42-5	Styrene / Ethylbenzene / Styrol /	LT 1.0 E -2	UGG D
	Styrolene / Cinnamene *		
10061-01-5	cis-1,3-Dichloropropylene / cis-1,3-	LT 1.0 E -2	UGG D
	Dichloropropene		
107-06-2	1,2-Dichloroethane	LT 1.0 E -2	UGG D
108-05-4	Vinyl acetate / Acetic acid vinyl	LT 1.0 E -2	UGG D
	ester		
108-10-1	Methyl isobutyl ketone /	LT 1.0 E -2	UGG D
	Isopropylacetone / 4-Methyl-2-pen*		
108-88-3	Toluene	LT 1.0 E -2	UGG D
108-90-7	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG D
110-75-8	2-Chloroethyl vinyl ether / (2-	LT 1.0 E -2	UGG D
	Chloroethoxy)ethene		
124-48-1	Dibromochloromethane /	LT 1.0 E -2	UGG D
	Chlorodibromomethane		
127-18-4			

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-3	SAIC01D	0.0	16-MAY-97	UB	97U01661	VMS4/S	127-18-4	Tetrachloroethylene /	LT 1.0 E -2	UGG D		
								156-59-2	Tetrachloroethene / Perchloroethylen*				
									cis-1,2-Dichloroethylene / cis-1,2-	LT 1.0 E -2	UGG D		
									Dichloroethene				
								156-60-5	trans-1,2-Dichloroethylene / trans-	LT 1.0 E -2	UGG D		
									1,2-Dichloroethene				
								56-23-5	Carbon tetrachloride	LT 1.0 E -2	UGG D		
								591-78-6	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG D		
								67-64-1	Acetone	1.2 E -2	UGG JPB		
								67-66-3	Chloroform	LT 1.0 E -2	UGG D		
								71-43-2	Benzene	LT 1.0 E -2	UGG D		

71-55-6	1,1,1-Trichloroethane	LT 1.0 E -2	UGG D
74-83-9	Bromomethane	LT 1.0 E -2	UGG D
74-87-3	Chloromethane	LT 1.0 E -2	UGG D
75-00-3	Chloroethane	LT 1.0 E -2	UGG D
75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG D
75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG D
75-15-0	Carbon disulfide	LT 1.0 E -2	UGG D
75-25-2	Bromoform	LT 1.0 E -2	UGG D
75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG D
75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG D
75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG D
75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG D
75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG D
78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG D
78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG D
79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG D
79-01-6	Trichloroethylene / Trichloroethene / Ethinyl trichloride / T*	LT 1.0 E -2	UGG D
79-34-5	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG D
120-36-5	Xylenes, total combined	LT 1.0 E -2	UGG D
1918-00-9	trans-1,3-Dichloropropene	LT 1.0 E -2	UGG D
7085-19-0	2-(2,4-Dichlorophenoxy)propionic acid	LT 1.00 E -2	UGG
	Dichloroprop		
	Dicamba / 2-Methoxy-3,6-dichlorobenzoic acid	LT 1.00 E -2	UGG
	(+/-)-2-(4-Chloro-2-methylphenoxy)propionic acid / MCPP / *	LT .2	UGG
75-99-0	Dalapon / alpha,alpha-Dichloropropionic acid / 2,2-Dichloro*	LT 1.00 E -2	UGG
88-85-7			

\* - Analyte Description has been truncated. See Data Dictionary

- 242 -

30-JAN-98

16:17:59

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Lab Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas	Flag Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-4	SAIC01	0.0	16-MAY-97	ES SNSA*681	HBGI/S	88-85-7	Dinoseb / 2,4-Dinitro-6-sec-butylphenol / 2-sec-Butyl-4,6-*	LT 1.00 E -2	UGG			
							93-72-1	245TP / Silvex / 2-[2,4,5-	LT 1.00 E -2	UGG			

Final Documentation Appendix Report  
Installation : Fort Sheridan, IL (SN)  
File Type: CSE  
Sampling Date Range: 01-SEP-96 30-JAN-98

93-76-5	Trichlorophenoxy)propionic acid *				
	245T / (2,4,5-Trichlorophenoxy)acetic acid / Trioxone / We*	LT 1.00 E -2	UGG		
94-74-6	(4-Chloro-2-methylphenoxy)acetic acid	LT .2	UGG		
94-75-7	/ (4-Chloro-o-tolyl)*				
	2,4-D / 2,4-Dichlorophenoxyacetic acid	LT 1.00 E -2	UGG		
94-82-6	2,4-DB / 4-(2,4-	LT 1.00 E -2	UGG		
	Dichlorophenoxy)butyric acid				
UB 97U01662 EXL4/S 118-96-7	2,4,6-Trinitrotoluene / alpha-Trinitrotoluene	LT .2	UGG		
121-14-2	2,4-Dinitrotoluene	LT .1	UGG		
121-82-4	RDX / Cyclonite / Hexahydro-1,3,5-trinitro-1,3,5-triazine *	LT .2	UGG		
2691-41-0	Cyclotetramethylenetetranitramine	LT .2	UGG		
479-45-8	Tetryl / N-Methyl-N,2,4,6-tetranitroaniline / Nitramine / *	LT .2	UGG		
606-20-2	2,6-Dinitrotoluene	LT .2	UGG		
88-72-2	2-Nitrotoluene	LT .4	UGG		
98-95-3	Nitrobenzene / Essence of mirbane / Oil of mirbane	LT .2	UGG		
99-08-1	3-Nitrotoluene	LT .4	UGG		
99-35-4	1,3,5-Trinitrobenzene	LT .1	UGG		
99-65-0	1,3-Dinitrobenzene	LT .1	UGG		
99-99-0	4-Nitrotoluene	LT .4	UGG		
	2-Amino-4,6-dinitrotoluene	LT .2	UGG		
	4-Amino-2,6-dinitrotoluene	LT .2	UGG		
GAS2/S 7440-38-2	Arsenic	2.77	UGG		
GPB1/S 7439-92-1	Lead	11.3	UGG		
GSE2/S 7440-36-0	Antimony	LT .305	UGG		
GSE2/S 7782-49-2	Selenium	LT .25	UGG		
GTL2/S 7440-28-0	Thallium	LT .2	UGG		
HGCL/S 7439-97-6	Mercury	LT .1	UGG		
ICP3/S 7429-90-5	Aluminum	2890	UGG		
7439-89-6	Iron	14800	UGG		
7439-95-4	Magnesium	38500	UGG		
7439-96-5	Manganese	256	UGG		
7439-98-7	Molybdenum	1.2	UGG		
7440-02-0	Nickel	7.02	UGG		
7440-09-7	Potassium	489	UGG		
7440-22-4	Silver	LT .5	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

- 243 -

30-JAN-98

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)  
File Type: CSE

16:17:59



Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab No.	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-4	SAIC01	0.0	16-MAY-97	UB	97U01662	ICP3/S	7440-23-5	Sodium	532	UGG		
								7440-31-5	Tin	LT 5	UGG	J	
								7440-39-3	Barium	8.95	UGG JP		
								7440-41-7	Beryllium	LT .5	UGG		
								7440-42-8	Boron	10.2	UGG		
								7440-43-9	Cadmium	LT .5	UGG		
								7440-47-3	Chromium	11.4	UGG		
								7440-48-4	Cobalt	3.42	UGG		
								7440-50-8	Copper	3.99	UGG		
								7440-62-2	Vanadium	61.9	UGG		
								7440-66-6	Zinc	53.8	UGG		
								7440-70-2	Calcium	80000	UGG		
							PST2/S	1024-57-3	Heptachlor epoxide	4.11 E -4	UGG JP		
								1031-07-8	Endosulfan sulfate	LT 1.00 E -3	UGG		
								1104-28-2	PCB 1221	LT 1.30 E -2	UGG		
								11096-82-5	PCB 1260	LT 1.30 E -2	UGG		
								11097-69-1	PCB 1254	LT 1.30 E -2	UGG		
								11141-16-5	PCB 1232	LT 1.30 E -2	UGG		
								12672-29-6	PCB 1248	LT 1.30 E -2	UGG		
								12674-11-2	PCB 1016	LT 1.30 E -2	UGG		
								309-00-2	Aldrin	5.55 E -4	UGG JP		
								319-84-6	alpha-Hexachlorocyclohexane / alpha-Benzene hexachloride	8.79 E -4	UGG BJP		
								319-85-7	Beta-Hexachlorocyclohexane / beta-Benzene hexachloride	4.74 E -4	UGG* BJP		
								319-86-8	delta-Hexachlorocyclohexane / delta-Benzene hexachloride	1.27 E -3	UGG BU		
								33213-65-9	Endosulfan II / beta-Endosulfan	LT 1.00 E -3	UGG		
								50-29-3	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane	1.19 E -3	UGG JP		
								5103-71-9	alpha-Chlordane	3.45 E -4	UGG JP	I	
								53469-21-9	PCB 1242	LT 1.30 E -2	UGG		
								53494-70-5	Endrin ketone	LT 1.00 E -3	UGG		
								5566-34-7	gamma-Chlordane	3.25 E -4	UGG JP		
								58-89-9	Lindane / gamma-Benzene hexachloride / gamma-Hexachlorocyc	7.57 E -4	UGG JP		
								60-57-1	Dieldrin	3.74 E -4	UGG JP		
								72-20-8	Endrin	4.84 E -4	UGG BJP		
								72-43-5	Methoxychlor / Methoxy-DDT / 1,1'-(2,2-Trichloroethylidene	1.42 E -3	UGG JP		
								72-54-8	ppDDD / 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane / Rhoth*	2.43 E -3	UGG C		
								72-55-9	2,2-Bis(p-chlorophenyl)-1,1-dichloroethene	1.04 E -3	UGG JP		

\* - Analyte Description has been truncated. See Data Dictionary

30-JAN-98

16:17:59

Final Documentation Appendix Report  
Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-4	SAIC01	0.0	16-MAY-97	UB	97U01662	PST2/S	7421-93-4 76-44-8	Endrin aldehyde Heptachlor / 1H-1,4,5,6,7,8,8- Heptachloro-3a,4,7,7a-tetra*	LT 1.00 E -3 3.15 E -4	UGG JP		
								8001-35-2	Toxaphene / Chlorinated camphene / Campechlor / Alltox / *	LT .1	UGG		
								959-98-8	Endosulfan I / alpha-Endosulfan	LT 1.00 E -3	UGG		
						SKV3/S		100-01-6	4-Nitroaniline	LT .14	UGG		
								100-02-7	4-Nitrophenol	LT .14	UGG		
								100-51-6	Benzyl alcohol	LT .14	UGG		
								105-67-9	2,4-Dimethylphenol	LT .14	UGG		
								106-44-5	p-Cresol / 4-Cresol / 4-Methylphenol	LT .14	UGG		
								106-46-7	1,4-Dichlorobenzene	LT .14	UGG		
								106-47-8	4-Chloroaniline	LT .14	UGG		
								108-60-1	Bis(2-chloroisopropyl) ether	LT .14	UGG		
								108-95-2	Phenol / Carbolic acid / Phenic acid / Phenyllic acid / Phe*	LT .14	UGG		
								111-44-4	Bis(2-chloroethyl) ether	LT .14	UGG		
								111-91-1	Bis(2-chloroethoxy) methane	LT .14	UGG		
								117-81-7	Bis(2-ethylhexyl) phthalate	LT .14	UGG		
								117-84-0	Di-n-octyl phthalate	LT .14	UGG		
								118-74-1	Hexachlorobenzene	LT .14	UGG		
								120-12-7	Anthracene	LT .14	UGG		
								120-82-1	1,2,4-Trichlorobenzene	LT .14	UGG		
								120-83-2	2,4-Dichlorophenol	LT .14	UGG		
								121-14-2	2,4-Dinitrotoluene	LT .14	UGG		
								129-00-0	Benzo[def]phenanthrene / Pyrene	LT .14	UGG		
								131-11-3	Dimethyl phthalate	LT .14	UGG		
								132-64-9	Dibenzofuran	LT .14	UGG		
								191-24-2	Benzo[ghi]perylene	LT .14	UGG		
								193-39-5	Indeno[1,2,3-C,D]pyrene	LT .14	UGG		
								205-99-2	Benzo[b]fluoranthene / 3,4- Benzo[fluoranthene	LT .14	UGG		
								206-44-0	Fluoranthene	LT .14	UGG		
								207-08-9	Benzo[k]fluoranthene	LT .14	UGG		
								208-96-8	Acenaphthylene	LT .14	UGG		
								218-01-9	Chrysene	LT .14	UGG		
								50-32-8	Benzo[a]pyrene	LT .14	UGG		
								51-28-5	2,4-Dinitrophenol	LT .14	UGG		
								53-70-3	Dibenz[ah]anthracene / 1,2:5,6-	LT .14	UGG		

\* - Analyte Description has been truncated. See Data Dictionary

- 245 -

30-JAN-98

16:17:59

Final Documentation Appendix Report

Installation :Fort Sheridan, IL (SN)

File Type: CSE

Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab Anly. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Meas Codes	Flag Data	EPA Data Quals
LAKE	SD-SOUTH-4	SAIC01	0.0	16-MAY-97	UB 97U01662	SMV3/S	59-50-7	3-Methyl-4-chlorophenol / 4-Chloro-3-cresol / 4-Chloro-3-m*	LT .14	UGG		
							606-20-2	2,6-Dinitrotoluene	LT .14	UGG		
							621-64-7	N-Nitrosodi-n-propylamine	LT .14	UGG		
							65-85-0	Benzoic acid	LT .14	UGG		
							67-72-1	Hexachloroethane	LT .14	UGG		
							77-47-4	Hexachlorocyclopentadiene	LT .14	UGG 2		
							78-59-1	Isophorone	LT .14	UGG		
							83-32-9	Acenaphthene	LT .14	UGG		
							84-66-2	Diethyl phthalate	LT .14	UGG		
							94-74-2	Di-n-butyl phthalate	LT .14	UGG		
							85-01-8	Phenanthrene	LT .14	UGG		
							85-68-7	Butylbenzyl phthalate	LT .14	UGG		
							86-30-6	N-Nitrosodiphenylamine	LT .14	UGG		
							86-73-7	Fluorene / 9H-Fluorene	LT .14	UGG		
							86-74-8	Carbazole / 9H-Carbazole	LT .14	UGG		
							87-68-3	Hexachlorobutadiene / Hexachloro-1,3-butadiene	LT .14	UGG		
							87-86-5	Pentachlorophenol	LT .14	UGG		
							88-06-2	2,4,6-Trichlorophenol	LT .14	UGG		
							88-74-4	2-Nitroaniline	LT .14	UGG		
							88-75-5	2-Nitrophenol	LT .14	UGG		
							91-20-3	Naphthalene / Tar camphor	LT .14	UGG		
							91-57-6	2-Methylnaphthalene	LT .14	UGG		
							91-58-7	2-Chloronaphthalene	LT .14	UGG		
							91-94-1	3,3'-Dichlorobenzidine	LT .14	UGG		
							95-48-7	o-Cresol / 2-Cresol / 2-Methylphenol	LT .14	UGG		
							95-50-1	1,2-Dichlorobenzene	LT .14	UGG		
							95-57-8	2-Chlorophenol	LT .14	UGG		
							95-95-4	2,4,5-Trichlorophenol	LT .14	UGG		
							98-95-3	Nitrobenzene / Essence of mirbane /	LT .14	UGG		

Oil of mirbane  
 3-Nitroaniline  
 4-Bromophenyl phenyl ether  
 4-Chlorophenyl phenyl ether  
 Ethylbenzene  
 Styrene / Ethylbenzene / Styrol /  
 Styrolene / Cinnamene \*  
 cis-1,3-Dichloropropylene / cis-1,3-  
 Dichloropropene  
 1,2-Dichloroethane  
 Vinyl acetate / Acetic acid vinyl  
 ester

99-09-2  
 VMS4/S 100-41-4  
 100-42-5  
 10061-01-5  
 107-06-2  
 108-05-4  
 108-10-1

LT .14  
 LT .14  
 LT .14  
 LT 1.0 E -2  
 LT 1.0 E -2  
 LT 1.0 E -2  
 LT 1.0 E -2  
 LT 1.0 E -2  
 LT 1.0 E -2  
 LT 1.0 E -2

UGG  
 UGG  
 UGG  
 UGG  
 UGG  
 UGG  
 UGG  
 UGG  
 UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 246 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation :Port Sheridan, IL (SN)

File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

Site Type	Site ID	Field Sample No.	Depth	Sample Date	Lab. No.	Meth/ Matrix	CAS No.	Analyte Description	Me Bo Conc	Unit Flag Meas Codes	Data Quals	EPA Data Quals
LAKE	SD-SOUTH-4	SAIC01	0.0	16-MAY-97	UB	97U01662	VMS4/S	108-10-1	Methyl isobutyl ketone / Isopropylacetone / 4-Methyl-2-pent* Toluene	LT 1.0 E -2	UGG	
								108-88-3	Chlorobenzene / Monochlorobenzene	LT 1.0 E -2	UGG	
								108-90-7	2-Chloroethyl vinyl ether / (2-Chloroethoxy)ethene	LT 1.0 E -2	UGG	
								110-75-8	Dibromochloromethane / Chlorodibromomethane	LT 1.0 E -2	UGG	
								124-48-1	Tetrachloroethylene / Tetrachloroethene / Perchloroethylen*	LT 1.0 E -2	UGG	
								127-18-4	cis-1,2-Dichloroethylene / cis-1,2-Dichloroethene	LT 1.0 E -2	UGG	
								156-59-2	trans-1,2-Dichloroethylene / trans-1,2-Dichloroethene	LT 1.0 E -2	UGG	
								156-60-5	Carbon tetrachloride	LT 1.0 E -2	UGG	
								56-23-5	Methyl n-butyl ketone / 2-Hexanone	LT 1.0 E -2	UGG	
								591-78-6	Acetone	1.0 E -2	UGG	JPB
								67-64-1	Chloroform	LT 1.0 E -2	UGG	
								67-66-3	Benzene	LT 1.0 E -2	UGG	
								71-43-2	1,1,1-Trichloroethane	LT 1.0 E -2	UGG	
								71-55-6	Bromomethane	LT 1.0 E -2	UGG	
								74-83-9	Chloromethane	LT 1.0 E -2	UGG	
								74-87-3	Chloroethane	LT 1.0 E -2	UGG	
								75-00-3	Chloroethane	LT 1.0 E -2	UGG	

75-01-4	Vinyl chloride / Chloroethene	LT 1.0 E -2	UGG
75-09-2	Methylene chloride / Dichloromethane	LT 1.0 E -2	UGG
75-15-0	Carbon disulfide	LT 1.0 E -2	UGG
75-25-2	Bromoform	LT 1.0 E -2	UGG
75-27-4	Bromodichloromethane	LT 1.0 E -2	UGG
75-34-3	1,1-Dichloroethane	LT 1.0 E -2	UGG
75-35-4	1,1-Dichloroethylene / 1,1-Dichloroethene	LT 1.0 E -2	UGG
75-43-4	Freon / Dichlorofluoromethane	LT 1.0 E -2	UGG
75-69-4	Trichlorofluoromethane	LT 1.0 E -2	UGG
78-87-5	1,2-Dichloropropane	LT 1.0 E -2	UGG
78-93-3	Methyl ethyl ketone / 2-Butanone	LT 1.0 E -2	UGG
79-00-5	1,1,2-Trichloroethane	LT 1.0 E -2	UGG
79-01-6	Trichloroethylene / Trichloroethene / Ethinyl trichloride / T*	LT 1.0 E -2	UGG
79-34-5	Tetrachloroethane / 1,1,2,2-Tetrachloroethane / Acetylene *	LT 1.0 E -2	UGG
	Xylenes, total combined	LT 1.0 E -2	UGG
	trans-1,3-Dichloropropene	LT 1.0 E -2	UGG

\* - Analyte Description has been truncated. See Data Dictionary

- 247 -

30-JAN-98

16:17:59

Final Documentation Appendix Report  
 Installation : Fort Sheridan, IL (SN)  
 File Type: CSE  
 Sampling Date Range: 01-SEP-96 30-JAN-98

\*\* End of Report - 9019 Records Found \*\*